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TEXAS AGRICULTURAL EXPERIMENT STATION

A. B. CONNER, DIRECTOR
COLLEGE STATION, BRAZOS COUNTY, TEXAS

FIFTIETH ANNUAL REPORT
1937

IMPERIAL MYCOLOGICAL INSTITUTE
22 APR. 1939

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
T. O. WALTON, President

Staff

AGRICULTURAL EXPERIMENT STATION
Agricultural and Mechanical College of Texas

September 1, 1938

MAIN STATION

Administration:

A. B. Conner, M. S., Director
R. E. Karper, M. S., Vice-Director
P. C. Mangelsdorf, Sc. D., Assistant Director
Clarice M. Turner, B. A., Secretary
M. P. Holleman, Chief Clerk
Reed McDonald, Assistant Chief Clerk
Chester Higgs, Executive Assistant
Howard Berry, B. S., Technical Assistant

Chemistry:

G. S. Fraps, Ph. D., Chief; State Chemist
J. F. Fudge, Ph. D., Chemist
A. R. Kemmerer, Ph. D., Chemist
T. L. Ogier, B. S., Associate State Chemist
E. C. Carlyle, M. S., Associate Chemist
P. F. Macy, Ph. D., Associate Chemist
Joseph Semb, Ph. D., Associate Chemist
S. E. Asbury, M. S., Assistant State Chemist
A. J. Sterges, M. S., Assistant Chemist
*Ray Treichler, M. S., Assistant Chemist
W. W. Meinke, B. S., Assistant Chemist
G. L. Smith, B. S., Assistant Chemist
S. M. Greenburg, B. S., Assistant Chemist
J. L. Kelch, B. S., Assistant Chemist
F. C. Pack, B. S., Assistant Chemist
W. H. Walker, Analyst
Valma Graham, Analyst

Horticulture:

S. H. Yarnell, Sc. D., Chief
W. S. Flory, Ph. D., Horticulturist

Range Animal Husbandry:

J. M. Jones, A. M., Chief
B. L. Warwick, Ph. D., Animal Husbandman
J. H. Jones, B. S., Animal Husbandman
S. P. Davis, Wool and Mohair Investigations

Entomology:

F. L. Thomas, Ph. D., Chief; State Entomologist
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R. K. Fletcher, Ph. D., Entomologist
W. L. Owen, Jr., M. S., Entomologist (P. O., Terrell)
J. C. Gaines, Jr., Ph. D., Entomologist
S. E. Jones, M. S., Entomologist (P. O., Winter Haven)
*J. N. Roney, M. S., Entomologist
Henry Menusan, Jr., Ph. D., Entomologist
R. W. Moreland, B. S., Assistant Entomologist (coop. U.S.D.A.)
G. A. Russell, Pharm. G., B. S., Agent (coop. U.S.D.A.)
Cecil E. Heard, B. S., Chief Foulbrood Inspector
Claude Burgin, B. S., Foulbrood Inspector

Agronomy:

E. B. Reynolds, Ph. D., Chief
R. E. Karper, M. S., Agronomist
P. C. Mangelsdorf, Sc. D., Agronomist
R. L. Hensel, M. S., Agronomist
H. V. Geib, Ph. D., Field Representative, Soil Cons. Research (coop. U.S.D.A.)
E. S. McFadden, B. S., Associate Agronomist (coop. U.S.D.A.)
D. T. Killough, M. S., Agronomist

Agronomy:—Continued

T. R. Richmond, Assistant Agronomist (coop. U.S.D.A.)
H. E. Rea, B. S., Agronomist
D. A. Reid, M. S., Agronomist, (Amarillo)
R. E. Harper, B. S., Jr. Botanist (coop. U.S.D.A.)

Publications:

A. D. Jackson, Chief

Veterinary Science:

H. Schmidt, D. V. M., Chief
T. W. Workman, D. V. M., Veterinarian
P. L. Piercy, D. V. M., Veterinarian
R. D. Turk, D. V. M., Veterinarian

Plant Pathology and Physiology:

A. A. Dunlap, Ph. D., Chief
W. N. Ezekiel, Ph. D., Plant Pathologist
*G. M. Watkins, Ph. D., Plant Pathologist
L. M. Blank, Ph. D., Assoc. Plant Pathologist (coop. U.S.D.A.)
G. A. Greathouse, Ph. D., Assoc. Plant Physiologist (coop. U.S.D.A.)
N. E. Rigler, Ph. D., Plant Physiologist
G. E. Alstatt, M. S., Plant Pathologist

Farm and Ranch Economics:

L. P. Gabbard, M. S., Chief
C. A. Bonnen, M. S., Farm Management Specialist
C. H. Hamilton, Ph. D., Economist, Rural Life
W. E. Paulson, Ph. D., Marketing Specialist
A. C. Magee, M. S., Economist in Farm Management
H. C. Bradshaw, M. A., Economist, Farm Taxation
P. H. Czarowitz, B. A., Field Asst. in Farm and Ranch Records

Rural Home Research:

Jessie Whitacre, Ph. D., Chief
Mary Anna Grimes, M. S., Textile and Clothing Specialist
Sylvia Cover, Ph. D., Foods Specialist

Soil Survey:

W. T. Carter, B. S., Chief (coop. U. S. D. A.)
E. H. Templin, B. S., Soil Surveyor (coop. U. S. D. A.)
J. W. Huckabee, Jr., B. S., Soil Surveyor
I. C. Mowery, B. S., Soil Surveyor
H. M. Smith, B. S., Asst. Soil Surveyor (coop. U. S. D. A.)
Springs)

Botany:

V. L. Cory, M. S., Acting Chief (P. O. Sonora)

Swine Husbandry:

Fred Hale, M. S., Chief

Dairy Husbandry:

O. C. Copeland, M. S., Acting Chief
F. E. Hanson, M. S., Associate in Dairy Mfg.

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*On leave 1938-39

Poultry Husbandry:

R. M. Sherwood, M. S., Chief
J. R. Couch, M. S., Poultry Husbandman
L. E. James, B. S., Asst. Poultry Husbandman

Agricultural Engineering:

H. P. Smith, M. S., Chief

Wildlife Research:

W. P. Taylor, Ph. D., Chief (coop. U. S. D. A.)
Valgene Lehman, B. S., Field Biologist (coop. U. S. D. A.)

Main Station Farm:

J. E. Roberts, B. S., Superintendent

Apiculture, San Antonio:

H. B. Parks, B. S., Chief
A. H. Alex, B. S., Queen Breeder

Feed Control Service:

F. D. Fuller, M. S. Chief
James Sullivan, Assistant Chief
S. D. Pearce, Secretary
J. H. Rogers, Feed Inspector
K. L. Kirkland, B. S., Feed Inspector
S. D. Reynolds, Jr., Feed Inspector
P. A. Moore, Feed Inspector
E. J. Wilson, B. S., Feed Inspector
H. G. Wickes, D. V. M., Feed Inspector
J. K. Francklow, Feed Inspector
R. A. Turck, Feed Inspector

Members of Teaching Saff Carrying Cooperaive Projects on the Station:

G. W. Adriance, Ph. D., Horticulture
S. W. Bilsing, Ph. D., Entomology
D. Scoates, A. E., Agricultural Engineering
A. K. Mackey, M. S., Animal Husbandry
R. G. Reeves, Ph. D., Biology
J. N. Quisenberry, Ph. D., Genetics
J. S. Mogford, M. S., Agronomy
F. R. Brison, M. S., Horticulture
C. N. Shepardson, M. S., Diary Husbandry
A. L. Darnell, M. A., Dairy Husbandry
V. A. Little, M. S., Entomology
P. B. Pearson, Ph. D., Animal Husbandry

SUBSTATIONS

No. 1, Beeville, Bee County:

R. A. Hall, B. S., Superintendent
E. M. Neal, B. S., Animal Husbandman

No. 2, Tyler, Smith County:

P. R. Johnson, M. S., Superintendent (coop, U. S. D. A.)
J. C. Ratsek, Ph. D., Horticulturist, Rose Investigations
E. W. Lyle, Ph. D., Plant Pathologist, Rose Disease Investigations
J. B. Pope, M. S., Project Leader, S. C. S. (coop. U. S. D. A.)
O. C. Word, B. C. E., Agrl. Engineer, S. C. S. (coop. U. S. D. A.)

No. 3, Angleton, Brazoria County:

R. H. Stansel, M. S., Superintendent
H. M. Reed, B. S., Horticulturist

No. 4, Beaumont, Jefferson County:

R. H. Wyche, Superintendent
A. L. Martin, Ph. D., Plant Physiologist
H. M. Beachell, M. S., Asst. Agronomist (coop. U. S. D. A.)

No. 5, Temple, Bell County:

C. H. McDowell, M. S., Superintendent (coop. U. S. D. A.)
C. H. Rogers, Ph. D., Plant Pathologist
H. O. Hill, B. S., Project Leader, S. C. S. (coop, U. S. D. A.)

No. 6, Denton, Denton County:

P. B. Dunkle, M. S., Superintendent
I. M. Atkins, B. S., Asst. Agronomist (coop. U. S. D. A.)

No. 7, Spur, Dickens County:

R. E. Dickson, B. S., Superintendent (coop. U. S. D. A.)
B. C. Langley, M. S., Agronomist (coop. U. S. D. A.)
C. E. Fisher, M. S., Asst. Soil Conservationist (coop. U. S. D. A.)

No. 8, Lubbock, Lubbock County:

D. L. Jones, Superintendent
Frank Gaines, Irrig. and Forest Nurseryman

No. 9, Balmorhea, Reeves County:

J. J. Bayles, B. S., Superintendent

No. 10, College Station, Brazos County:

R. M. Sherwood, M. S., In charge
L. J. McCall, Farm Superintendent

No. 11, Nacogdoches, Nacogdoches County:

H. F. Morris, M. S., Superintendent

No. 12, Chillicothe, Hardeman County:

J. Roy Quinby, M. S., Superintendent (coop. U. S. D. A.)
J. C. Stephens, M. S., Assoc. Agronomist (coop. U. S. D. A.)

No. 14, Sonora, Sutton-Edwards Counties:

W. H. Dameron, B. S., Superintendent
I. B. Boughton, D. V. M., Veterinarian
W. T. Hardy, D. V. M., Veterinarian
V. L. Cory, M. S., Range Botanist
O. G. Babcock, B. S., Asst. Entomologist (coop. U. S. D. A.)
O. L. Carpenter, Shepherd

No. 15, Weslaco, Hidalgo County:

W. H. Friend, B. S., Superintendent
J. F. Wood, B. S., Horticulturist
G. H. Godfrey, Ph. D., Plant Pathologist
T. B. Randolph, B. S., Entomologist
J. L. Heid, B. S., Chemist (coop. U. S. D. A.)

No. 16, Iowa Park, Wichita County:

L. E. Brooks, B. S., Superintendent
B. S. Pickett, M. S., Horticulturist

No. 19, Winter Haven, Dimmit County:

E. Mortensen, B. S., Superintendent
L. R. Hawthorn, M. S., Horticulturist (coop. U. S. D. A.)
S. S. Ivanoff, Ph. D., Plant Pathologist

FIELD LABORATORIES

Apicultural Research Laboratory, San Antonio:

H.B. Parks, B. S., Apiculturist, in charge (also Chief, Division of Apiculture)
A. H. Alex, B. S., Queen Breeder

East Texas Pasture Investigations Laboratory, Rt. 1, Lufkin:

E. K. Crouch, B. S., Agronomist. In charge

Truck Crop Insect Investigations Laboratory, Dickinson:

M. J. Janes, Ph. D., Entomologist. In charge

Loco Weed Research Laboratory, Alpine:

Frank P. Mathews, Ph. D., Veterinarian in charge (coop. U. S. D. A.)

Tomato Disease Laboratory, Jacksonville:

P. A. Young, Ph. D., Plant Pathologist in charge

Tomato Disease Laboratory, Yoakum:

A. L. Harrison, Ph. D., Plant Pathologist in charge

Sweet Potato Investigations Laboratory, Gilmer:

R. E. Wright, M. S., Horticulturist in charge

Grape Investigations Laboratory, Montague:

U. A. Randolph, B. S., Horticulturist in charge

Cotton Insect Laboratory, Presidio:

A. J. Chapman, B. S., Assoc. Entomolgist in charge (coop. U. S. D. A.)

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FIFTIETH ANNUAL REPORT, 1937

A. B. CONNER, Director

The Texas Agricultural Experiment Station is one of the main divisions of the Agricultural and Mechanical College of Texas. In addition to the work at the Main Station at College Station, it supports sixteen substations and nine field laboratories serving different agricultural regions of the State.

The work of the Agricultural Experiment Station is concerned with the development of the State's agricultural resources and opportunities. It is not uncommonly the case that in the development of agricultural resources there follows immediately as a result industrial development in the form of processing of agricultural products. In this way, the work of the Agricultural Experiment Station is intimately related not only to the welfare of those engaged in and dependent upon agriculture but also to the development of certain related industries.

The primary function of agricultural research is to increase our knowledge of agriculture and related fields so that we can proceed along sound lines in developing, utilizing, and conserving our agricultural resources. The work of the Agricultural Experiment Station also furnishes to the several institutions engaged in teaching agriculture reliable information to impart to students. It serves in a definite way the Extension Service in the application of reliable facts and procedures to farm and ranch lands. It likewise serves the vocational teachers and students with reliable information in vocational fields. The results of research are published and distributed to farmers, ranchmen, and other interested individuals, and to libraries and agencies engaged in the dissemination of reliable agricultural information.

In the development of the State's agricultural resources, many problems are encountered, such as diseases of both plants and animals, the development of new and better suited crops for the different regions, the problem of how to conserve and utilize the soil and water resources to best advantage, the systems of cropping best suited to the different areas, and the development of new agricultural enterprises possible in certain areas. It is the business of the Agricultural Experiment Station not only to be concerned with the development of our resources under existing conditions, but also to foresee, if possible, agricultural problems which may become acute in the future and to endeavor to secure information which will enable us to avoid encountering serious problems in the future and thus preserve the agricultural industries already developed.

It is well recognized that when any problem or series of problems are encountered the greatest need is a widening of our knowledge of these problems and their relationships. It is not possible for the Agricultural Experiment Station with its present resources to solve all the problems of agriculture in a short time. Nevertheless, the following report shows the scope of the work of this agency and the progress made in solving or alleviating some of our most urgent agricultural problems.

ORGANIZATION AND WORK

The Agricultural Experiment Station System comprises the Main Station with twenty divisions at College Station, sixteen substations in the several agricultural regions of the State, and nine field laboratories, as follows:

Divisions

Administrative
Veterinary Science
Chemistry
Horticulture
Range Animal Husbandry
Entomology
Agronomy
Plant Pathology and Physiology
Farm and Ranch Economics
Soil Survey
Botany
Swine Husbandry
Dairy Husbandry
Poultry Husbandry
Rural Home Research
Apiculture
Feed Control Service
Agricultural Engineering
Wildlife Research
Publications

Substations

No. 1, Beeville, Bee County
No. 2, Tyler, Smith County
No. 3, Angleton, Brazoria County
No. 4, Beaumont, Jefferson County
No. 5, Temple, Bell County
No. 6, Denton, Denton County
No. 7, Spur, Dickens County
No. 8, Lubbock, Lubbock County
No. 9, Balmorhea, Reeves County
No. 10, College Station, Brazos County
No. 11, Nacogdoches, Nacogdoches County
No. 12, Chillicothe, Hardeman County
No. 14, Sonora Sutton-Edwards Counties
No. 15, Weslaco, Hidalgo County
No. 16, Iowa Park, Wichita County
No. 19, Winter Haven, Dimmit County

Field Laboratories

Apiculture Research Laboratory, San Antonio, Bexar County.

Truck Crop Insect Investigations Laboratory, Dickinson, Galveston County.

Cotton Insect Laboratory, Presidio County.

Loco Weed Laboratory, Alpine, Brewster County.

East Texas Pasture Investigations Laboratory, Lufkin, Angelina County.

Tomato Disease Laboratory, Jacksonville, Cherokee County.

Tomato Disease Laboratory, Yoakum, Lavaca County.

Sweet Potato Laboratory, Gilmer, Upshur County.

Grape Laboratory, Montague, Montague County.

LANDS

The following table shows the acreage available to the Agricultural Experiment Station of the Agricultural and Mechanical College of Texas, for research purposes:

	Total	State-owned	Leased or use donated
MAIN STATION:			
Agronomy farm	94	94	....
Horticultural farm	65	50	15
Veterinary Science	141	141	....
Plant Pathology	4	2	2
Entomology	6	1	5
SUBSTATIONS:			
1. Beeville	449.7	449.7	....
2. Tyler	455.2	455.2	....
3. Angleton	159.3	159.3	....
4. Beaumont	100	100	....
5. Temple	647	541	106
6. Denton	209.92	209.92	....
7. Spur	413.92	413.92	....
8. Lubbock	160	160	....
9. Balmorhea	200	200	....
10. College Station	920.8	920.8	....
11. Nacogdoches	81.6	81.6	....
12. Chillicothe	252	222	30
14. Sonora	3,461.63	3,461.63	....
15. Weslaco	100	100	....
16. Iowa Park	161.79	161.79	....
19. Winter Haven	192	192	....
Big Spring (Federal)	80	....	80
FIELD LABORATORIES:			
Apicultural (San Antonio)	10	10	....
East Texas Pasture (Lufkin)	228.67	217.57	11.1
Truck Crop Insect (Dickinson)	20	....	20
Sweet Potato (Gilmer)	65	....	65
Grape (Montague)	25	....	25
Loco Weed (Alpine)	1	....	1
Cotton Insect (Presidio)	6	....	6
Tomato Disease (Jacksonville)	45	....	45
Tomato Disease (Yoakum)	25	....	25
Total	8,780.53	8,344.43	436.1

VETERINARY SCIENCE

Loin Disease in Cattle

Efforts are being continued at obtaining the organism responsible for loin disease in pure culture. This is a most difficult task since it must depend entirely on a chance isolation by picking up the right organism from among many others.

To meet the frequent statements of stockowners who lost cattle from loin disease that their premises are clear of carcass material, experiments were undertaken to see whether a mouse dead from loin disease in the laboratory would produce loin disease in a cow. In two out of three trials the cow developed loin disease when drenched with the putrid material of one mouse dead from loin disease, one and two months respectively. When a white rat was used to drench a cow, loin disease developed in one out of four trials. Since the rats could not be killed with the loin disease culture by injection of the same, the loin disease culture was placed in the rat's stomach with a stomach tube. The rat was killed about an hour later. The dead rats were then kept at room temperature for 36, 42, 100, and 113 days respectively.

H. Schmidt.

Soremouth in Kids and Lambs

Experiments on this project were conducted at the Sonora Station, and are reported under that head.

H. Schmidt.

Anaplasmosis in Cattle

Anaplasmosis is a disease of great economic importance to the cattle industry in Texas, where it occurs especially in the coastal region, causing greatest losses among older animals and during the warmer seasons. The blood of animals that have recovered remains infective for at least 6½ years and probably much longer. At present such recovered or carrier animals can be detected only by injecting their blood into a susceptible animal. Such carrier animals remain a constant source of infection and from them the infection is carried to susceptible animals. The manner in which this takes place in Texas is not yet known, although formerly the Texas Fever tick transmitted it. Other ticks have also been found to transmit it in other states and countries. Biting flies must also be considered as possible vectors.

The recently organized project plan provides for a study of the possible insect vectors of anaplasmosis in Texas. Buildings and other equipment have, therefore. been designed to meet insect-proof, especially fly-proof, requirements at the main laboratory at College Station, where anaplasmosis is not known to be prevalent among the cattle. From here excursions are undertaken into the coastal country where outbreaks of the disease frequently occur and where the insect vectors must therefore be present.

In carrying on this field work, experimental animals are transported by trailer. Three animals, including one susceptible control, one carrier and one susceptible experimental animal, are taken on each trip. A screened fly-proof compartment is provided on the trailer for the protection of the susceptible experimental animal while enroute, but the other two cattle are not so protected. An insect-proof screened stall was constructed on the field location in which the susceptible experimental animal is kept while not under observation. The experience with the fly-proof equipment during the year has proven entirely satisfactory for experimental purposes.

One tick transmission study has been completed with specimens of *Dermacentor variabilis*. Nymphs that had engorged as larvae on a carrier animal were permitted to feed on a susceptible animal 1A. Temperatures remained normal on this animal for a period of 150 days after attachment of larvae, after which it was assumed that the transmission attempt was unsuccessful, from the standpoint of producing anaplasmosis.

Additional tick transmission attempts are now in the course of study with different developmental stages of *Amblyomma maculatum*. Ticks that are being maintained under laboratory conditions for future transmission studies include specimens of *Amblyomma maculatum, Dermacentor variabilis* and *Ixodes ricinus* var. *scapularis*.

All attempts to transmit the disease from carrier to susceptible animals by means of flies have yielded negative results. The fly transmission attempts were made by taking all three animals into the field and watching for biting flies to settle on the carrier animal while the attendant keeps them off the two susceptible animals. When such a fly alights a glass funnel is cautiously slipped over it. The fly is allowed to feed for a short time in order to get its proboscis soiled with fresh blood. It is then cautiously transferred with the funnel to the susceptible experimental animal where it is allowed to engorge. It is then captured and preserved for identification.

Animal 2A was exposed to the infection by four bites of *Tabanus atratus,* two bites by *T. lineatus*, three bites by *Chrysops nigra* and one bite by *Chrysops* (sp.?) in three days. A temperature record was kept on this animal for 161 days and remained normal throughout.

Animal 4A received transmission bites from seven specimens of *T. atratus* in three successive days. A temperature record for 146 days following exposure failed to indicate positive transmission of anaplasmosis.

Animal 5A exposed to bites from five specimens of *T. sulcifrons* failed to show a positive temperature reaction in 134 days following exposure.

Animal 6A was exposed by three bites only from *Chrysops* (sp. ?) in three days. The daily temperature record for 125 days following exposure remained normal throughout, indicating negative results.

A total of thirty-five animals have been injected during the year with infective blood to produce immunization to anaplasmosis. None of these animals exceeded one year of age. The results show that fever reactions indicating positive immunization began on an average of about thirty-one days after injection and lasted for an average of seven and one-half days.

To obtain some idea as to the length of time an animal will continue to harbor anaplasmosis in a chronic carrier form the past station records were studied. One animal was recorded as a carrier over a period of five years and two months, after which she was sold on the market. Another, which is the present reservoir for immunization purposes has harbored the infection six and one-half years. The organism in the blood from each of these animals showed no decrease in virulency when last tested.

H. Schmidt, P. L. Piercy.

Infectious Bovine Abortion

The clean dairy herd of the Feeding and Breeding Station was moved to the old premises where the Bang infected herd was formerly kept after the grounds were vacant for ten months and thoroughly cleaned and disinfected, the broken places in the concrete floors removed and replaced by new concrete.

There were fifty-four calvings during the year requiring seventy-eight services or 1.44 service per conception. One abortion occurred but the cow remained negative to Bang's disease test. Four cows suffered from retained placenta. The herd thus remains free from Bang's disease.

In the College dairy herd repeated blood testing for Bang's disease revealed the presence of twenty-five suspicious animals, all of which were removed from the main herd and either sold or used to establish an infected herd. Of the seven bulls used in the herd five were suspicious on more than one test. Sixty-three conceptions resulted in fifty-nine normal parturitions and four abortions, one of the latter being positive for Bang's disease.

H. Schmidt, R. D. Turk.

Trichomonad Abortion in Cattle

(In cooperation with Department of Dairy Husbandry)

Trichomonad abortion in cattle, a disease recently found in the United States, caused by a flagellated protozoan, was found in the College Dairy herd in February, 1936. This disease may cause very disastrous losses from early abortions which usually occur in the first half of the gestation period. The disease is transmitted by an infected cow to the bull from where it is transmitted to the cow. The bull may remain a transmitter for a long time, depending upon the location of the infection in his uro-genital tract. Many observers consider the bull incurable, while the cow readily cleans herself of the infection without any treatment except sexual rest.

In our treatment of the disease no therapeutic consideration was given to the cow. Breeding operations were suspended for six months and in the meantime the penis of the bulls were thoroughly washed with warm 5% solution of oxyquinolin sulphate every eight to ten days. These treatments were continued for nine months, although breeding operations were resumed three months after such treatments began. The result of the treatments was that all cows bred to the previously infected bulls promptly conceived, resulting in fifty-nine normal calves being born, in one abortion at seven months and two abortions at eight months and one mummified fetus. In none of these could trichomonas infection be established.

H. Schmidt, R. D. Turk, C. N. Shepardson.

Loco Weed Poisoning

(In cooperation with Bureau of Animal Industry, U. S. Department of Agriculture)

Previous experiments have shown that cottonseed cake alone as a supplementary feed on the range would not prevent cattle from eating loco, *Astragalus earlei.* Continuing the experiments, it was found that cottonseed cake plus alfalfa leaf meal or cottonseed cake plus alfalfa leaf meal plus blackstrap molasses when fed supplementary also failed to prevent the eating of loco weed on the range. Observations made indicate that when an abundance of young green grass is available, cattle will stop eating loco weed.

Frank P. Mathews.

Swamp Fever in Horses and Mules

Work on this project has been suspended on account of lack of material but will be resumed when conditions and facilities permit.

H. Schmidt.

Miscellaneous Poisonous Plants

Red-Stemmed Peavine (Astragalus emoryanus) Poisoning. Serious losses from grazing on this plant were observed on several ranches. Cattle poisoned on this plant chiefly showed a locomotor ataxia, while sheep chiefly showed respiratory disturbances. Symptoms of locomotor ataxia were produced in two goats by feeding the plant either in the green or dry state. The dry plant fed to sheep produced the same symptoms as observed in sheep contracting it by feeding on the plant on the range. It is of interest to note that on some ranches in the Davis Mountains this species of plant was abundant and was grazed extensively by sheep and cattle, but no ill effects developed therefrom.

Sacahuista Poisoning. In previous experiments the feeding of buds and blooms of sacahuista *(Nolina texana)* to sheep and goats produced icterus and liver and kidney degeneration but no photosensitization, as is always found in animals feeding on these parts of the plant on the range. When, however, the animals were fed the plant in diffuse light until well defined icterus was produced and then allowed fresh green grass, and at the same time exposed to direct sunlight, photosensitization did develop, but not when dry alfalfa was substituted for the fresh green grass. The results indicate that sacahuista buds and blooms lack the photodynamic agent found in lechuguilla, and that a photodynamic agent could not be extracted with ethyl alcohol, as in the case of lechuguilla.

Sartwellia flaveriae. Four goats were killed by feeding this plant. Three of the animals had been fed the plant over long periods in previous experiments with no evident ill effects except frequent loss of appetite. Death in these cases was due to hydrothorax. A slight hepatic cirrhosis was observed but no ascites. The fourth animal had not been fed the plant prior to its introduction into this experiment. As has been the case in all other animals when the feeding of the plant is continued after loss of appetite occurred, and with no previous feeding history, there was no ascites, no hydrothorax but a marked necrosis of the liver.

Senecio Poisoning. The toxic principles in two species of senecio, *S. longilobus* and *S. Riddelli*, was found to be soluble in alcohol and toxic for rats. After extraction the ethyl alcohol was distilled off and the residue extracted with ether. The ether soluble fraction was found to be slightly toxic, the ether insoluble fraction very toxic. The minimum lethal dose of the ether insoluble fraction of the ethyl alcohol extract was found to be between 100 and 150 mg. The administration of 40 to 45 mg. doses daily for three to five consecutive days produced fatal results in some rats but not in others. In the fatal cases death occurred within seven to fourteen days after receiving the last dose. The rats which did not die within fourteen days appeared to be on the road to recovery thirty days after receiving their last dose when they were killed for autopsy. The rats which were killed by one or two doses of the extract showed nothing but pronounced necrosis of the liver. Those which lived as much as a week after receiving the first dose showed subcutaneous edema of the abdominal wall, icterus, marked liver and kidney degeneration with slight ascites. In addition to these changes the cases which lived as much as fourteen days showed a marked ascites. Fibroblastic proliferation begins in the liver as early as one week but never has the aggressive or progressive appearance as that which is observed in cattle from this form of poisoning. There is a marked bile duct proliferation and possibly considerable liver regeneration. The swollen condition of both cytoplasm and nucleus which is observed in the hepatic parenchyma of cattle is a prominent feature of this form of poisoning in rats.

The extract from both species of the plant appeared to be equal in toxicity.

A methyl alcohol extract was found to be much less toxic than the ethyl alcohol extract.

Frank P. Mathews.

Jimmies in Sheep and Goats

A feeding experiment in which six parts bone meal, two parts cottonseed meal, and one part salt were offered under range conditions to a flock of sheep in which so-called "Jimmies" occurred was inconclusive because losses from "Jimmies" continued for only three days after the mixture became available to the sheep. On another ranch a severe outbreak of "Jimmies' occurred in all pastures but one. In this pasture the sheep had been fed 1/2 lb. cottonseed cake per day for a month just previous to the outbreak.

Frank P. Mathews.

Effect of Moldy Feed on Sheep and other Farm Animals

Work on this Project has been interrupted on account of lack of culture material from the field. For a number of years there have been no complaints from poisoning in sheep by spoiled feed. Until such new cases occur work on this project must remain inactive.

H. Schmidt.

Vitamin A Requirements for Beef Cattle

(In cooperation with Divisions of Range Animal Husbandry and Chemistry, and Bureau of Animal Industry, United States Department of Agriculture.)

The experiments for Vitamin A requirements for beef cattle are carried on at Substation No. 7, Spur, where 50 choice quality Hereford yearling steers were used. The steers when removed from the range were still suckling. They were placed on a vitamin A depletion ration a few days after removal from the range. All but one group of ten steers were placed on the depletion ration from the beginning and as they became depleted were placed in groups of ten and fed definite levels of carotene in alfalfa meal. The one group of nine steers not depleted from the beginning also received the depletion ration to which 800 micrograms per 100 lbs. live weight of carotene as alfalfa meal were added daily. These nine steers developed night blindness as follows: one on the 110th day, two on the 145th day, three on the 181st day, and three on the 202nd day.

The forty steers on a ration devoid of vitamin A became night blind after being placed on the ration as follows: ten steers in 71 to 84 days, twenty-six in 107 to 121 days and one each on the 147th, 152nd, 180th, and 183rd day. As the steers became night blind they were placed in four groups of ten each and fed the following levels of carotene in alfalfa meal: 450, 600, 750, and 1000 micrograms respectively per 100 lbs. live weight. All steers went forward to a higher degree of night blindness after the addition of carotene to their ration.

Five steers of Group I receiving 450 micrograms of carotene were removed to College Station on May 12, 1937, and turned over to the Division of Veterinary Science for further observation. At this time the steers were completely night blind. Here they were continued on the same ration and the same level of carotene. During the hot weather these steers suffered greatly, as evidenced by panting with open mouth and protruded tongue and profuse salivation. As the weather got cooler this condition improved, and it ceased entirely in September. Lighter symptoms occurring were lacrymation, nasal discharge, dribbling of saliva, convulsions, irregular food consumption, and swelling of the legs, sometimes to a marked degree.

Two of the five steers died from the effects of vitamin A deficiency, one 230 days and the other 234 days after the beginning of the experiment. One of the steers showed inability to stand on his hind legs, which condition developed in the course of three days. Autopsy showed extensive inflammation of both sciatic nerves, extensive muscular and subcutaneous edema. Both eyes showed corneal and conjunctival lesions. There was thickening of the dural sheath of the left optic nerve, no stenosis of the optic canal. A coronary thrombosis was probably the immediate cause of death. Microscopically both sciatic nerves showed medullary sheath degeneration. Posterior columns of spinal cord in the lumbar region showed some degeneration. Some degeneration of the optic nerve extending to the lateral geniculate body was also observed.

In the blood, sugar, protein, calcium and phosphorus were normal. The liver assayed 205 "blue units" per gram, and 4.5 parts per million spectro vitamin A. In the other steer a ruptured fourth stomach was found. This may have been caused by the steer falling violently to the ground during a convulsive seizure. The optic nerves showed extensive medullary sheath degeneration.

The eyes and optic nerves of a number of the steers marketed direct from the Spur Substation were secured and examined. In general it was found that the optic nerves showed slight to complete medullary sheath and axis cylinder degeneration extending to the lateral geniculate body and the superior collicules. There was extensive proliferation of the trabeculae and optic nerve sheaths, but in the examination of over sixty steers stenosis of the optic canal has not been observed. Pyramidal tract degeneration has been demonstrated in three steers to-date.

In twelve steers examined the retinal changes are those of a marked atrophy and optic nerve degeneration. In three other steers no significant retinal changes but very extensive optic nerve degeneration were found. These steers had been carried to extreme depletion.

H. Schmidt, T. W. Workman.

Vitamin A Requirements of Sheep and Goats

In a study of the symptomatology, pathology, and vitamin A requirements of sheep and goats, both old and young animals are being used.

They are being fed a ration consisting of cottonseed hulls, cottonseed meal and ground kafir; wheat bran was included in the ration of some of them. Its inclusion in the ration had no effect upon the development of vitamin A deficiency. Five aged ewes with nursing lambs were placed on a depletion ration in April, 1936, while two similar ewes were slaughtered and the livers tested for carotene and vitamin A. One ewe had 1.7 parts per million carotene and 349.2 parts per million spectro vitamin A, while the liver of the other ewe had 0.5 parts per million carotene and 253.5 parts per million spectro vitamin A. None of these ewes was placed on carotene so that the continuous course of symptoms and lesions could be studied. Of the five ewes one died unexpectedly after 273 days without symptoms of vitamin A deficiency having been observed, one died after 280 days, one after 538 days, one after 598 days, while the fifth is still living after 673 days. This ewe has a ragged fleece, is emaciated and night blind, but so far has shown no other symptoms. Symptoms shown in these aged ewes were not constant and consisted in nasal discharge, convulsions, night blindness, eye lesions including opacity of the cornea or opacity of the lens, rough fleece, emaciation, and complete loss of appetite.

Of six aged Angora nanny goats placed on experiment in July, 1936, one died intercurrent after 172 days without having shown symptoms, one died after 382 days, one after 403 days, one after 422 days, one after 479 days, while the sixth is still living after 573 days without having shown any symptoms. Symptoms shown during deficiency were usually gradual loss of weight, weakness, night blindness, cough, heavy tenacious nasal discharge, anemia, lacrymation, corneal opacity, keratitis, loss of appetite and death.

In January, 1937, nine yearling lambs and eleven yearling Angora goats were placed on experiment. Two of the lambs were placed on carotene when they had emaciated to miserable looking wretches and showed all the other symptoms of vitamin A deficiency, while the other seven lambs died within 144 to 270 days after being placed on depletion ration. The symptoms observed paralleled in the main those observed in the old sheep. Of the eleven yearling goats, two are still living, while the others died from 255 to 393 days after the beginning of the experiment. In these young goats the typical symptom is gradual loss of weight till the animal is finally so weak it can no longer rise to its feet, resulting in the most part from a gradual decline in food consumption. Coupled with this is, in the majority of cases, a marked anemia. Night blindness is also observed and in some cases a profuse tenacious nasal discharge.

Four native cross-bred lambs and one native cross-bred two-year-old ewe were depleted of vitamin A and placed on 650 micrograms carotene per 100 lbs. live weight in alfalfa meal per day. Two of the lambs had been depleted till they were emaciated miserable looking wretches. All five of the animals made comparatively rapid gains in weight after the carotene was added to their ration, and three of the animals that have been on this carotene level for over fifteen months have become quite fat. Of these three animals one shows no night blindness while the other two are doubtful. The remaining two lambs on carotene for 102 days are still showing night blindness.

H. Schmidt.

Disease Resistance in Animals

(In cooperation with Division of Range Animal Husbandry)

Progress of this project is reported in the Division of Range Animal Husbandry.

CHEMISTRY

Factors of Soil Fertility

Considerable differences were found in the availability of the total phosphoric acid and total potash of a number of soils of different origin, by means of experiments which were similar to those used for fertilizers. The causes of these differences are being studied. Work on the effect of calcium carbonate on the phosphoric acid, potash and nitrogen as taken from soils by crops, is being prepared for publication.

G. S. Fraps.

Composition of Soils

The average chemical composition of the various soil types found in Texas and the grade assigned to the quantity of the constituents of these soils have been presented in Bulletin 549. Maps are given showing the prevailing grades of the constituents of the upland surface soils in the various parts of the State for total nitrogen, active phosphoric acid, total phosphoric acid, active potash, acid-soluble potash, total potash, acid-soluble lime, basicity, acidity, and acid-soluble magnesia. The maps show that Texas has large areas of soil low in phosphoric acid and nitrogen, as well as some areas high in these constituents. Areas low in potash are smaller than those low in nitrogen and phosphoric acid and the areas high in potash are larger. The western part and the extreme southern part of the State are usually higher in nitrogen, phosphoric acid and potash than the eastern part. In general, Texas soils are well supplied with lime. Some areas in the eastern part of the State are low in lime and some of the soils of these areas may become sufficiently acid to require liming. Texas soils are not likely to be deficient in magnesia, iron, or manganese. Alluvial soils are better supplied with plant food than are upland soils of the same region.

Chemical analyses of soils of Falls, Polk, Scurry, Wheeler, Hardeman, Cass, and Dickens Counties are being prepared for publication. The constituents of these soils are being classified in five grades, according to the quantity present, with Grade 1 being the highest and Grade 5 the lowest.

G. S. Fraps and J. F. Fudge.

Fertilizers Affect Composition of Soils

The effects of fertilization of a Lufkin fine sandy loam at College Station upon the chemical composition of the soil have been studied. Of the total amount of nitrogen applied over an eight-year period, 50 to 70 per cent was found in the surface 6 inches of soil; only a small amount had penetrated into the subsoil. From 36 to 48 per cent of the phosphoric acid added was found as active phosphoric acid in the surface soil, and considerable quantities of the phosphoric acid had penetrated into the subsoil. Potash fertilization considerably increased the active potash in the surface soil and significantly increased that in the subsoil. Phosphoric acid and potash had little, if any, effect on soil acidity, nitrogen (added as sulphate of ammonia) increased it, and manure decreased it. Phosphoric acid and nitrogen contents of oats grown on the soil were fairly well related to the quantities of these constituents in the soil while the oats were in a vegetative stage of growth, but the relation was not close in the oats cut near maturity. The relation with respect to potash was irregular at both stages of growth. A paper giving results of the study has been published in the Journal of the American Society of Agronomy. A similar study of the effects of fertilization on a Lake Charles clay at Angleton has been started. This work is in cooperation with the Division of Agronomy.

G. S. Fraps, J. F. Fudge, and E. B. Reynolds.

The fixation of phosphate from dipotassium phosphate solution has been found, on further evidence, to be highly correlated with the iron and aluminum compounds in the soil and only slightly correlated with the lime content, which confirms results presented in Bulletin 304. Freshly precipitated iron and aluminum hydroxides had very strong fixing powers for phosphate from dipotassium phosphate solution, while freshly precipitated calcium carbonate had a relatively low fixing power.

Much interest has been aroused in water-culture methods for commercial growing of flowers and vegetables by articles in the popular magazines, though little regarding the details of the work has been published by the Experiment Station concerned. On account of the number of questions received regarding this matter a small amount of work was done on this subject. The plants did not grow in a satisfactory manner, and the procedure did not appear to be promising except under special conditions. More satisfactory results were secured with sand. The Department of Landscape Art, cooperating with this Division, used a complete nutrient mixture prepared from commercial fertilizer salts for growing hot-house flowers in sand. Growth of the flowers tried was as good as in soil mixtures and was more dependable and uniform.

G. S. Fraps and Paul Macy.

Nitrification

Dicalcium phosphate and rock phosphate have no basic action in stimulating nitrification in soils which require addition of calcium carbonate in order to nitrify. Magnesium carbonate and dolomite are not as effective in promoting nitrification in such soils as calcium carbonate. This work has been published in the Journal of the American Society of Agronomy.

Phosphates are effective on a few soils of low nitrifying capacity which do not respond to other treatments. Superphosphate or dicalcium phosphate usually have a beneficial effect on nitrification in such soils, while rock phosphates have little effect. This work is being prepared for publication.

The claim that nitrogen is lost rapidly when nitrites are added to acid soils has been verified, since nitrites are formed as an intermediate in nitrification. The possibility of loss of nitrogen during nitrification in such soils has been studied. The results indicate that no such loss of nitrogen takes place.

The amount of ammonia-nitrogen nitrified as ammonia found in some soils is almost in direct proportion to the amount of the calcium carbonate added. However, there appears to be no such consistent relation in the oxidation of the organic nitrogen of these soils. The toxic effect of calcium cyanamid on the nitrifying organisms is being studied. Work on the isolation and study of the nitrifying organisms from different soils in sections of Texas and on the nitrifying capacity of Texas soils will be continued.

G. S. Fraps and A. J. Sterges.

Root Rot Investigations

Organic substances in the roots of certain resistant plants inhibit the growth of the root rot fungus. This work has been prepared for publication by the Division of Plant Pathology and Physiology.

J. F. Fudge.

Further tests on the germination of sclerotia in closed containers indicate that, although sclerotia germinate in air lower in oxygen and higher in carbon dioxide than normal air, some oxygen is necessary for their germination.

Zinc and manganese, as sulphates, at about three parts per million, were found greatly to increase the growth of the root rot fungus in liquid culture; while at about 300 p.p.m. they were strongly inhibitory. Aluminum, boron, ferric iron, and ferrous iron at a concentration of 10 milliequivalents per liter were not inhibitory. Copper was inhibitory at 1 but not at 0.1 m.e. per liter.

With the exception of the roots from one slightly acid soil, decoctions of roots from Half & Half cotton collected late in the season from soils of different pH values gave no indication of an inhibitory constituent.

Cultures adjusted to pH 7.0 were found to become acid on autoclaving, and growth of the root rot fungus was usually increased by readjusting the pH of such cultures. Adding neutral potassium salts of citric, tartaric, and oxalic acid to artificial cultures caused an increase in the acidity at harvest but had no effect on the yield of the fungus.

A large number of samples have been analyzed, solutions have been prepared, and other work done for the Division of Plant Pathology and Physiology. Cooperation has been given to that Division as shown in their report. Related work has been done on soils as reported elsewhere.

The results of a number of studies on the relation of soil acidity to cotton root rot have been presented in Bulletin 545, a joint publication of the Division of Chemistry and Plant Pathology and Physiology.

G. S. Fraps and Paul Macy.

The Relation of Soil Composition to Plant and Animal Deficiencies

The study of the relation of soil composition to plant and animal deficiencies has been continued. Particular attention was given to the phosphoric acid, protein, and lime content of the forage, since it is known that a deficiency of these elements in the ration results in physiological disturbances in the growth and development of cattle. Over 1600 samples of forage plants from 12 counties in the East Texas Timber Country, 12 counties in the Gulf Coast Prairie, and 12 counties in the Rio Grande Plain have been secured and analyzed for phosphoric acid, lime, and protein since this work was begun in 1936. Collections of forage samples along the Gulf Coast were made in cooperation with the Bureau of Animal Industry, United States Department of Agriculture. In addition to the phosphoric acid and lime in a number of these samples, crude fiber, water, ash, potash, manganese, and copper have been determined. A large proportion of the samples contained less phosphoric acid than has been shown to be required for the proper development of cattle. Protein is also probably deficient in a number of the samples.

A close relation was found between phosphoric acid and protein contents of the samples. Lime was not deficient in most samples although in some samples it was low. Phosphoric acid and protein decreased and lime increased as the plants passed from the early vegetative stage through blooming to maturity. Samples of different species of grasses collected from a single location at the same time differed widely in composition. Samples of the same species on different soils also varied in composition. In the East Texas Timber Country, soils of the Ruston and Norfolk series produced forage lowest in phosphoric acid and protein, while soils of the Wilson-Crockett group produced forage highest in these constituents. Samples of soil have been collected from the locations from which forage samples were secured, and were analyzed to ascertain the relation between the composition of the soil and the composition of the forage plants.

A short paper discussing the lime, phosphoric acid, and protein in forage grasses of the East Texas Timber Country was presented at the 1937 meeting of the Soil Science Society of America and will appear in Volume 2 of the Proceedings of that society. Bulletins giving the results of the study in the East Texas Timber Country and the Gulf Coast Prairie will be prepared.

G. S. Fraps and J. F. Fudge.

Loco Poison

Water solutions of the free base obtained from Oxytropis saximontana and from Astragalus mollissimus produced locoism when fed to cats.

The nature of the phosphotungstate formed when phosphotungstic acid is added to an aqueous solution of the extract from Astragalus earlei has been studied further. Part of this phosphotungstate is soluble in alcohol. This fraction contains the locoine. The alcohol-insoluble phosphotungstate, when crystallized from acetone by the addition of alcohol, yields well defined crystals. The free base from this phosphotungstate when fed to cats does not cause locoism. Locoine phosphotungstate is somewhat soluble in water, and this phosphotungstate can be extracted by means of amyl alcohol. The sugar extracted from the loco plant has been crystallized. Preparations of locoine have been made which are more concentrated than those previously reported.

Joseph Semb.

Productive Values of Animal Feeds

The productive energy of a mixed feed and the maintenance requirements for small chickens have been calculated from experiments made in previous years. Very little information has been available regarding the utilization of energy by chickens, although it appeared possible that they utilize a greater percentage of the food energy than ruminants. On account of the importance of having an exact basis for comparison with other feeds, eleven experiments on practically the same feed were made with 4 to 10 chicks in each lot, and with a total of 256 chicks, including the preliminary chicks. In each experiment, one lot of chicks was on full feed, and one lot on limited feed, receiving about half the quantity fed those on full feed. The chicks were analyzed at the end of the experiment, while corresponding chicks were analyzed at the beginning. The maintenance requirements and productive energy were calculated by the algebraic equation, $WM+Ce=FX$, in which W is the weight or surface of the chick, M the maintenance requirements per unit of weight or surface, Ce the gain in energy in calories, F the grams of feed eaten and X the productive energy of the feed. After inserting the data secured from the chicks on limited feed, and the corresponding data from those on full feeds in the same experiment, the maintenance requirements and the productive energy were secured by solving the two equations. Much higher values were secured for maintenance requirements of the chicks and productive energy of the mixture when the maintenance requirements were calculated on the assumption that they were in proportion to the weight of the chickens, than when calculated on the assumption that maintenance requirements were in proportion to the surface. The maintenance requirements on the surface basis were much too low when compared with data for basal energy requirements, secured by other workers. The corresponding values for productive energy were also much too low when compared with the value for productive energy of corn secured by H. H. Mitchell and associates. For these reasons, the higher values for maintenance and for productive energy secured by the calculation on the weight basis were considered to be correct. As much as 50 per cent difference was found in the maintenance requirements for chicks in the two different experiments, but no corresponding difference in the productive energy of the mixture was found to occur. The maintenance requirements of the chicks on full feed and on limited feed thus depended upon environmental conditions and both were affected in the same way. It is evident that the two lots must be kept under the same conditions to avoid errors due to differences in maintenance requirements. Maintenance requirements and productive energy were also calculated for individual chicks, and found to differ appreciably from the average values. Productive energy and maintenance requirements should thus be determined by the use of a sufficient number of animals to average out the individual differences. Results from a small number of chicks may have large factors of error. This work is being prepared for publication.

Several similar experiments have been made to compare the productive energy of various chicken feeds. The productive energy of these feeds will be calculated on the basis of the values secured in the work described above.

G. S. Fraps and E. C. Carlyle.

Productive Energy of Human Foods

The productive energy of a food is the energy available for use after all the losses of energy due to digestion have been subtracted. The productive energy of human foods will be determined with chickens from a comparison of the quantity of fat and flesh produced on a given quantity of food, compared with the same quantity of standard food, or some similar procedure. Experiments of this kind are mentioned in the section on productive energy of animal feeds.

Seven series of experiments to determine the productive energy have been carried out with chicks. The foods tested were corn meal, patent, low grade and graham flours, oatmeal, wheat bran, dried sweet potatoes, rice, raw navy beans, lima beans, and dried black eye peas. The chicks were fed in groups of six chicks on each food.

Both the composition and the digestion coefficients are used in calculating productive energy. All available human digestion experiments (about 1250) have been tabulated, and the data are being classified and studied. Since the use of small animals is much more convenient than the use of men, the relation of digestibility by human beings to digestibility by rats and chickens will be studied.

A series of 54 digestion experiments with human foods, using rats, were carried out. The foods tested included fresh vegetables secured on the local market and dried in the laboratory, flour, bread, cereals, and beans.

The effect of cooking on the digestibility of corn meal, Irish and sweet potatoes, oat meal, rice, navy beans, and dried black eye peas was determined. Cooking materially increased the digestibility of the beans and peas. The foods were fed in balanced rations containing at least 50 per cent of the food to be tested and 18 per cent protein.

Digestion experiments with chickens were made with cottonseed meal, alfalfa meal, dried buttermilk, tankage, feed corn meal, wheat gray shorts, wheat bran, dried cow peas, cream and pearl corn meal, patent, graham and low grade flours, macaroni, and rice.

An experiment was made to ascertain the biological values of the proteins of corn meal, oatmeal, and raw and cooked navy beans. The protein of the cooked beans had a materially higher value than the raw beans but was considerably lower than the protein of corn meal and oatmeal.

Copper, iron, and manganese were estimated in some special prepared samples of vegetables, flour, bread, cereals, feeds and plants.

G. S. Fraps and E. C. Carlyle.

Variations in the Vitamin Content of Texas Foods

Since it has been found that the vitamin A potency of practically all human foods and animal feeds of vegetables origin is derived from carotene or cryptoxanthin, the rapid chemical method of estimating carotene or cryptoxanthin can take the place of the expensive and time-consuming biological methods. The relation between the carotene content of various foods and feeds and the vitamin A potency as measured by rats is being studied in a number of samples. The data thus secured should aid in calculating vitamin A potency from their carotene content. Work on the method for estimating carotene has also been done and published in Bulletin 557. Butter fat, eggs, and liver are the chief foods which contain vitamin A potency both as vitamin A and carotene. Fish oils contain vitamin A with practically no carotene.

The relation between the amount of vitamin A and carotene found chemically in butter and the vitamin A potency as determined by the Sherman-Munsell technique has been developed. This relationship may be expressed by two algebraic equations. By use of either of these equations the vitamin A potency of butter, in Sherman-Munsell units, or in international units, can be calculated with a fair degree of accuracy from the amount of spectro vitamin A and carotene found chemically. This work is being published in Bulletin 560.

Similar experiments were carried out to determine the relation between the chemical analysis and the vitamin A potency of liver. So far only a few liver samples have been tested and it is planned to continue the work.

Work on the effect of different planes of carotene intake as the sole source of vitamin A potency, on the health and longevity of albino rats has been continued. The animals on 0.1 micrograms of carotene per gram of ration lived 93 days, on an average, while those on 0.2 micograms per gram lived 150 days. A few still remain alive on the 0.5 microgram level after over a year. A few animals have died on the higher levels of 1, 2, 3, and 4 micograms per gram of feed, but greater mortality is found in the lower levels, namely 0.5 and 1.0 micrograms of carotene per gram of feed. Upon breeding, no offspring was obtained from the rats fed the 0.1 and 0.2 level. The 0.5 level produced only a few offspring, and all the animals on the 1.0 level which were tested produced progeny.

G. S. Fraps, Ray Treichler, A. R. Kemmerer, and W. W. Meinke.

Quantitative Requirements of Vitamin A for Animals

The study of the quantitative requirements of chickens, dairy cattle, beef cattle, pigs, and sheep for vitamin A and of vitamin D for chickens has been continued in cooperation with the Divisions of Poultry Husbandry, Dairy Husbandry, Range Animal Husbandry, Swine Husbandry, and Veterinary Science. The work with beef cattle and sheep is also in cooperation with the Bureau of Animal Industry, United States Department of Agriculture. Carotene determinations were made at regular intervals on the alfalfa leaf meal or other feeds containing carotene fed to the above animals. Livers and butters were analyzed for vitamin A and carotene when such data were needed. Carotene when fed in oil was slightly more effective for growing chickens than when fed in alfalfa leaf meal. The effect of the amount of carotene upon milk production has been studied. This required the analysis of many samples of butter for vitamin A and carotene. Further information on these studies will be given by the various cooperating divisions. When carotene in alfalfa leaf meal to the extent of 19.9 parts per million was fed to rats, 17.6 per cent was digested, and when fed at the rate of 6.2 parts per million, 33.9 per cent was digested. The utilization of the carotene is greater from small amounts than from large amounts. Work on this important subject is being continued.

G. S. Fraps and A. R. Kemmerer.

Vitamins in Commercial Feeds

The work on vitamins in commercial feeds is being prepared for publication. Of all the vitamins so far discovered only vitamins A, D and G (flavin) are of practical importance in feeds for farm animals. Vitamin A is needed in the feeds of all farm animals. Some animals do not receive enough vitamin A. If chickens are confined indoors and do not have access to sunshine, they will need some vitamin D in their rations. Other farm animals will not likely require additions of vitamin D to their rations even if they are kept inside and do not receive sunshine. The hays and fodders which they eat contain enough of this factor to keep them in good health. Flavin is required by poultry in large amounts and their rations should be adjusted to contain a plentiful supply. Vitamins B and E and other factors are so widely distributed in nature that farm animals receive them abundantly in ordinary feeds. Vitamin C is not needed by any farm animals.

Vitamin A can be incorporated into mixed feeds by additions of products containing carotene, such as alfalfa meal, peanut hay, yellow corn and carotene in oil; vitamin D by additions of cod liver oil or other fish oils; and flavin by additions of dried skim milk, dried whey, cottonseed meal, alfalfa meal or other feeds.

Carotene was found to be lost less rapidly from feeds stored in large amounts than from feeds stored in small amounts. Feeds stored at refrigerator temperatures in a tightly packed condition, with a minimum of exposure to air, lost their carotene very slowly. Additional brands of fish oils were studied for the stability of vitamin A in them when they were mixed with feeds. Vitamin A was found to disappear rapidly in all the oils studied. This work is published in Bulletin 557. The vitamin D content of oils used in poultry feeding was ascertained as usual. Most of the oils tested were up to their guarantee in the content of vitamin D.

G. S. Fraps and A. R. Kemmerer.

Analyses of Commercial Feeds

Estimation of protein, fat, water, crude fiber, and ash and microscopic examinations were made on about 3555 samples of feed for the Division of Feed Control Service and the results were published in Bulletin 555 by the Division of Feed Control. Analyses for legal action were also made on a number of feed samples. Mineral and salt analyses were made on a number of samples requiring them. Assistance was also given in the formulation of definitions and rulings.

A large number of samples have been analyzed for minerals, protein, fat, and other constituents for the Divisions of Animal Husbandry, Dairy Husbandry, and Poultry Husbandry.

G. S. Fraps and T. L. Ogier.

Commercial Fertilizers

Samples of 1130 commercial fertilizers were collected and analyzed. In general, the composition was well up to that guaranteed by the manufacturer. The results of the inspection and analyses are published in Bulletin 553. Suggestions as to the fertilization of different crops are also given in this bulletin. A large number of samples were analyzed to determine their nonacid forming qualities. Most of the samples analyzed were found to have acid-forming qualities. The Chief of the Division is State Chemist and is in charge of the fertilizer law. He is also referee on fertilizers for the Association of Official Agricultural Chemists. The fertilizer manufacturers agreed upon 23 grades of mixed fertilizers to be sold in Texas during the season 1937-38.

G. S. Fraps, S. E. Asbury, and T. L. Ogier.

Iodine

The study of iodine in Texas feeds and waters has been continued and publications presenting the results of the study will soon be completed. Texas feeds and drinking waters seem to contain sufficient quantities of iodine for various animals so that there is no necessity for the addition of iodine to commercial feeds or to salt for animals. The iodine content of some of the samples of foods and feeds was quite high, and in none of the samples was it low enough to indicate the need of additional iodine.

G. S. Fraps and J. F. Fudge.

Miscellaneous

Analyses were made of a number of irrigation waters, minerals, feeds, grasses, etc. Investigational work is being done on various methods in use in the analytical work to determine factors which influence results.

G. S. Fraps.

HORTICULTURE

Fruit Adaptability Investigations

(In cooperation with Texas Extension Service)

The duration of cold required for the normal spring activity of peaches has been found to vary both with the variety and the location. A variety requires fewer hours below 45°F. in the southern part of the State than farther north for the same response as measured by the time before blooming in the greenhouse. Two types of behavior were observed: (a) practically all varieties require a certain amount of cold weather before there will be any activity upon exposing flowering wood to growing temperatures; the time required for the buds to open then decreases as the amount of time below 45° increases; and (b) other varieties show activity after exposure to some cold weather, but the time required for the flower buds to open does not decrease materially until there has been a considerable accumulation of hours below 45°. Hiley is one example of this second type. The amount of initial cold for the first signs of development varies enormously for the different varieties. For Saucer this is little or none. The amount for Hiley seems to vary from around 150 hours in South Texas to 600 hours in the northern part of the State. Elberta exposed to 150 hours below 45° at the Winter Garden station required over two months to come into bloom in the greenhouse. After 400 hours below 45° in the Winter Garden, and also after 1000 hours below 45° in the Wichita Valley it bloomed within two weeks in the greenhouse. Thirty-five varieties have tentatively been placed in seven groups based on tests on peach wood secured at intervals during the winter at the Main Station and Substations No. 2, 11, 16, and 19. Cold requirements of some of these are as follows: (very small) Saucer; (small) Babcock, the Honey varieties, and FPI 61,302; (very moderate) Hiley, Tardio Amarillo; (moderate) Family Favorite; (rather large) Frank, Katie, Salwey, Slappey; (large) Arp, Belle, Carman, Dr. Burton, Early Wheeler, Elberta, Heath Cling, Indian Cling, J. H. Hale, Mamie Ross, and Mayflower; (very large) Fair's Beauty.

The search for promising fruit seedlings has been continued in cooperation with the Texas Extension Service. Additional material has been secured for propagation and testing. Some of the peach seedlings are able to bloom and set well after a mild winter.

The peach and plum collection at Substation No. 11 near Nacogdoches has been considerably enlarged and now includes most of the promising new varieties of peaches. Only twenty of the sixty varieties of peaches at the Winter Garden station produced well during the past season. Bulletin No. 535 reports the results with fruit varieties at the Wichita Valley Station. A peach survey of the West Cross Timber area included the behavior of varieties under farm orchard conditions. The findings appear in Progress Report No. 482.

S. H. Yarnell, J. F. Rosborough, and substation superintendents.

Berry Adaptability and Breeding

Results of the extensive test of black and dew berry varieties at Substation No. 11, Nacogdoches, are being published in Station Bulletin No. 558. An account of the breeding work at this point may be found in the report of this substation.

At the Main Station 1100 plants from an F_4 selection of a Nessberry-raspberry backcross are being grown to secure a better picking variety than the parent, which has more of a raspberry flavor than the original Nessberry. Other families of seedlings include the Nessberry selfed, and selfed population, of an F_4 selection of a Nessberry-blackberry cross.

H. F. Morris, S. H. Yarnell.

Cultural Studies with the Blackberry

This work is being done at Substation No. 2 near Tyler and No. 11 near Nacogdoches. The work on berry sterility at the latter point has been reported as Technical Paper No. 437.

J. C. Ratsek, H. F. Morris.

Citrus Investigations

Adaptability and Breeding: Promising citrus under test at the Lower Rio Grande Valley station are the Glen citrangedin, Mineola tangerine, Perrine lemon, and the Louisiana Seedless and Rico oranges. No higher yields were obtained from Marsh grapefruit trees budded from a high yielding tree than from those budded from a low yielding tree. Additional crosses made at this station include Thorton tangelo x Ruby grapefruit and x Valencia orange, Temple x Valencia oranges, Texas Naval x Meyer lemon, and Valencia orange x Meyer lemon. Among the best Satsuma orange varieties under trial at the Winter Garden station are Foley, Horie Wase, Kawano Wase, Owari, Silverhill, and Sueoka Wase.

W. H. Friend, E. Mortensen, J. F. Wood, S. H. Yarnell.

Rootstocks: Sweet orange seedlings are not promising for use as a rootstock in the Lower Rio Grande Valley. Differences in behavior are being found among the various citranges as rootstocks for Satsumas at the Winter Garden Station.

W. H. Friend, E. Mortensen.

Cultural Studies with Grapefruit: The use of 10 pounds per tree of sulphate of ammonia in combination with 150 to 200 pounds per tree of hay or other bulky organic matter has given good results with grapefruit at the Lower Valley station. Commercial fertilizer has little or no effect on the yield of young trees, although the addition of organic matter increased the yield.

W. H. Friend.

Reclamation Studies: For an account of this work turn to the report of Substation No. 15, Weslaco.

W. H. Friend.

Orchard Heating: No records were obtained during the past season because of lack of cold weather.

J. F. Wood.

Citrus Storage: Crate liners were found to be effective in reducing loss of stored grapefruit from pitting and decay, in both cold and common storage. Grapefruit stores well at 45°F. for six weeks, oranges for three months.

W. H. Friend, J. F. Wood, G. H. Godfrey.

Cytological Investigations: Examination of the somatic chromosomes of the Meyer lemon from root-tip preparations indicates the following types: A, longest, two constrictions which usually produce a U-shape; B, nearly as long as A, a terminal constriction; C, somewhat shorter than either A or B, subterminal contriction; D, about the same length as C, medium constriction; E, medium in length, a satellite; F, G. H. below medium length, difficult to distinguish; I, shortest, loose median constriction to give frequently a V-shape. Other species have a similar scheme.

S. H. Yarnell.

Adaptability of Date Varieties

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

The palms have grown vigorously at both the Lower Rio Grande Valley and the Winter Garden substations. It is becoming increasingly apparent that fruit of the varieties under test will mature properly only with considerable difficulty at the former location. The varieties considered best at the latter point are Amir Hadj, Kustawy, and Braim. A number of local seedlings also are showing up well.

E. Mortensen, J. F. Wood.

Fig Investigations

Adaptability and Breeding: Many varieties, previously untested came into bearing during 1937 at Substation No. 3 near Angleton. Among the better varieties are Bourjassotte, De Grasse, and Gentile. Magnolia was crossed with two varieties of capri figs, the Hamma and the Boise Jaspee. Seedlings of Allison, Celestial, and Green Ischia pollinated by Hamma the previous season are being grown.

H. M. Reed, S. H. Yarnell, R. H. Stansel.

Processing Experiments: This work is being done at Substation No. 3, Angleton and is reported in full with the other experiments at that station.

H. M. Reed.

Grape Investigations

The best early grape varieties at the Winter Garden station are Lomanto, Monukka, and Khalili. Sultanina, Sultanina Rosea, Chasselas Fontainebleau, Alicante Bouschet, and Zinfandel ripen the latter part of June. These are very promising for commercial production in Southwest Texas. Sultania, Sultanina Rosa, and Monukka are being used to graft onto a number of different rootstocks. Dog Ridge, Champanel, and La Pryor continue to give good results as rootstocks. *Vitis candicans*, T.S. 22381, and T.S. 22379—all wild grapes—are also showing up well.

A site was picked out in Montague county for work on the adaptibility and breeding of American varieties and for cultural experiments.

In a test of the hot water method of emasculating grapes, the following lengths of time and temperatures were found to kill the pollen of unopened flowers without injuring the pistils: 52°C. for 2 minutes, 50° for 3 minutes, and 49° for 5 minutes. Lower temperatures and shorter periods did not kill any of the pollen; longer periods and higher temperatures injured the pistils. Apparently the effective range is fairly limited.

E. Mortensen, S. H. Yarnell, W. S. Flory.

Peach Breeding

Additional crosses were made at the Main Station between Anna, Dr. Burton, Hiley, Indian, and several Honey varieties during the past season. None of the seedlings of the earlier crosses have yet fruited. At the Wichita Valley Station crosses were made between Carman, Early Wheeler, Dr. Burton, Slappey, and J. H. Hale as pollen parent; also Mayflower x Slappey.

S. H. Yarnell, L. E. Brooks.

Plum Breeding

Fifty-one different combinations were attempted among sixteen varieties of plums where at least one (in 27 cases both) of the parent varieties were species hybrids with the Japanese plum, *Prunus salicina*, as one of the ancestors. Only twenty-six mature fruits, and seeds, were secured from approximately 15,000 pollinations. The results are striking in showing the cross-sterility that exists, at least in the varieties worked with, between (1) the different *P. salicina* hybrids; (2) *P. salicina* and *P. salincian* hybrids; and (3) *P. salicina* hybrids and a number of varieties of different origin. Other pollinations have indicated that a practically complete cross-sterility exists between Golden Beauty *(P. hortulana)* and both Wright's Early *(P. salicina)* and Burbank *(P. salicina)*. *Prunus hortulana* is itself, putatively, a hybrid between *P. americana* and *P. angustifolia*. In contrast to the above, 210 pollinations of Munson *(P. augustifolia varians)* with Burbank pollen gave seventeen sets and ten seeds after passing through a severe freeze. These results indicate that varietal improvement by breeding must begin with the selection of good, adapted varieties whose respective origins can be traced from single botanical species, and which possess some of the characters desired in the derivatives. Often such varieties, where they have the same chromosome number, will be cross fertile. Six hybrid varieties were tested for self-compatibility. Ten per cent of the Methley pollinations yielded mature fruits, but the other varieties gave no sets. A living collection of the forms of Prunus native to Texas, has been started. The plans have been revised on the basis of these results.

W. S. Flory, L. E. Brooks.

Strawberry Adaptability and Breeding

Station Bulletin No. 556 presents the results of the extensive variety trials at the Winter Garden station. Eight selections are being tested at eight widely scattered locations throughout the State. Some excel for home planting, some as commercial varieties. Additional selections are being tested at Substation No. 19, where the crosses were made and the preliminary testing done.

E. Mortensen, S. H. Yarnell.

Truck Crop Adaptability Investigations

Shipping Varieties: Results of recent work at the Winter Garden station have been presented in Station Bulletin No. 546. Results of the work at this station and at the Wichita Valley and Lower Rio Grande Valley stations are presented in the reports of these stations.

L. R. Hawthorn, W. H. Friend, L. E. Brooks.

Canning and Freezing Varieties: A new project to study this type of vegetable crops has been started at the Lower Rio Grande Valley Station in cooperation with the U.S.D.A. Citrus Products Laboratory on that station. Varieties of English peas and snap beans suitable for processing were investigated.

J. F. Wood, J. L. Heid.

Description of Vegetable Varieties: This work is in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture. Preliminary notes were taken with Dr. Roy Magruder on extensive varietal collections of eggplant and peppers.

L. R. Hawthorn.

Breeding Cabbage and Related Plants

Cabbage: Selections of desirable plants were made from commercial fields and from substation variety trials in the area south of Houston, in the Coastal Bend region, and in the Lower Rio Grande Valley. Most of these selections were made during mid-February at the height of the cabbage shipping season. The plants were stored at 40°F. for 60 days to induce earlier flowering, and then set in the field. High spring temperatures resulted either in preventing flower stalk formation or in abortion of pollen and subsequent lack of pod-setting where flowers occurred. No cabbage varietal cross resulted in good seed. This emphasized the desirability of using other methods for the 1938 program. Selfed lines of Volga and of Wisconsin All Seasons cabbage have been started from plants grown at College Station. A number of plants in the first generation of each selfed line are being carried for further inbreeding. Several crosses of cabbage with vegetables belonging to different botanical varieties of *Brassica oleracea* were made and are listed in the following section.

Crosses of Botanical Varieties: These crosses are being made to obtain (1) adapted types of high quality, and (2) possibly a new vegetable type. Crosses have been secured from seven different varietal combinations, three reciprocally. Considering kale and collards as distinct kinds of vegetables, we find the number of combinations made to be ten, four of which have been made reciprocally. They are as follows: kale x kohlrabi, kale x broccoli, collards x broccoli, kohlrabi x kale, kohlrabi x collards, kohlrabi x cabbage, kohlrabi x cauliflower, kohlrabi x broccoli, cabbage x kale, cabbage x collards, cabbage x kohlrabi, cabbage x cauliflower, broccoli x kale, broccoli x collards.

The F_1 of the broccoli x collards cross secured in 1936 was selfed and backcrossed reciprocally with each parent, and also crossed with kale. Plants of all these crosses have been set in the field, and one to several of each line are carried in the greenhouse. Second generation, backcross progenies. and, where possible, selected segregate inbred lines will be grown from these. Green sprouting broccoli, collards, and kohlrabi lines have been selfed and seed secured for second and third generation inbred lines.

Interspecific Crosses: These are being tried both for their genetic interest and for the possibility of yielding something of culinary value. Crosses have been attempted only between varities of *Brassica oleracea* and vareties of Chinese cabbage belonging to *B. pekinensis.* Ninety-two pollinations of the cross Wong Bok Chinese cabbage x Propageno broccoli resulted in thirty-six sets, thirty seeds and only two plants. In the early seedling stages these appeared quite similar to the parental Wong Bok. As they mature these still have the appearance of Chinese cabbage plants but differ from the female parent in having less wing on the petioles; almost even leaf margins that lack the serrations, crenateness or waviness of the Wong Bok leaves; and a lighter coloring over the entire plant. In addition the flowers which have appeared are quite abortive. From the cross North Carolina Short Stem collards x Pe Tsai Chinese cabbage thirty pollinations resulted in nineteen pods set. From the twelve seeds obtained one plant was secured. This, likewise, in the early seedling stages closely resembled the female parent, but it too shows probable hybrid characteristics as it matures. Since members of the true cabbage group have nine pairs of chromosomes while the Chinese cabbages have ten pairs, a cytological examination of the supposed hybrid derivatives should show whether they are true hybrids and would throw other light on the origin of these three plants.

Methods: In connection with this work some vernalization trials are being made on cabbage. Five hundred seeds were placed in moist germinating dishes and at the end of 6, 12, 17, 24, and 32 hours 100 seeds were removed, air dried and held with 100 untreated seeds at 41°F. One-third of each lot was planted at the end of 40 days, one-third at the end of about 70 days, and the remaining third will be removed from the cold box and planted at the end of 100 days. In the lots of the first planting chlorosis of the fourth to sixth leaves appearing was very evident. There was some difference in early growth rate among the different lots.

Cold-heat treatments have been given a number of plants to induce chromosome doubling. The plants, after being pollinated at intervals over a two-day period, were placed in the refrigerator at 45°F. and left for two days. They were then removed to a 95° box for one day. The crucifers tried thus far have been damaged and the treatment will be modified.

W. S. Flory.

Factors Affecting the Storage of Cucumbers

For information concerning this project turn to the reports of the Division of Rural Home Research and of Substation No. 19.

L. R. Hawthorn, Jessie Whitacre, S. H. Yarnell.

Factors Influencing the Quality and Yield of Onions

This work at the Winter Garden Station is being published in Station Bulletin No. 561. Additional commercial fertilizer tests are being made at Big Wells, Laredo, and Eagle Pass.

L. R. Hawthorn.

Potato Investigations

Tests of seed stocks and the effect of various fertilizers are being made in the Lower Rio Grande Valley. The use of cow peas as green manure was found to increase the yield materially.

W. H. Friend.

Factors Influencing the Quality and Yield of Spinach

This project was limited to irrigation experiments, at the Winter Garden Station. Infrequent irrigation gave higher yields than more frequent irrigation.

L. R. Hawthorn.

Tomato Investigations

Adaptability and Breeding: A selection of a Cherry-Bonny Best cross backcrossed to the large fruited parent made at the Winter Garden Station is being distributed for trial under commercial conditions. It has been given the name Summerset because it extends the fruiting season well into the difficult part of the summer. Promising selections have been made from Cooper's Special-Marglobe and Bonny Best-Cooper's Special crosses at the Lower Valley Station.

Crosses at the Main Station are of two types—those between large fruited varieties and those involving small fruited sorts. In a general way the objectives are the same in each case, namely, the breeding of high quality varieties well enough adapted to Texas conditions to extend the fruiting season. All of the commercial varieties are lacking in one or more respects. In breeding, one variety tends to supply what another lacks. It appears that a fairly large number of hereditary factors are involved in such characters as puffing and fruit setting under conditions of high temperature and low humidity. Thus the more varieties that can be combined in a single strain the better chance of securing a desirable combination of hereditary factors. For example, the best strain of dwarf x tall had 15.6% puff this year, the best strain of Stone x Gulf State Market 35%, while the best strain of a cross between these two hybrids had 10.3%. Carrying this a step further, it was found that the first generation of a cross between this double hybrid and a globe type had only 3.2% puff, and at the same time materially extended the fruiting season over the parent varieties. The first generation usually behaves somewhat better than later selections, as it is difficult to find plants that combine all of the factors from both parents as does the F_1.

Crosses between large and small fruited varieties back crossed once to the large fruited form combine a very low percentage of puff with a heavy set of fruit even late in the season. Size of fruit, while larger than the small fruited type, is still too small. The strain of the second back cross having the most puff had 5.7%. Fruits of these crosses range from medium to medium large and are fairly satisfactory; some of these also bear well late in the season.

L. R. Hawthorn, J. F. Wood, S. H. Yarnell.

Studies on Puffing: A number of varieties from France were grown, many of which puffed very little but the fruit was rather small and often had a decided woodiness. Among these were Allies, Claude Export, Claudia, Joffre, Marmonde, Perpignan, Pierette, Precoce des Halles, Sans Porcille, and Zenatas. Three English varieties gave fairly small percentages of puff but were not very satisfactory in other respects—Best of All 17%, Majestic 14%, and Princess of Wales 8%. Some of the American varieties previously unreported gave the following percentages of puff: Florida Special 25, Grothen Globe 24, Michigan State Forcing 40, Morse Special 8, New Orleans Market 37, Nystate 18, and Pearson 30. Marglobe, used as a check had 28, less than in most seasons.

S. H. Yarnell.

Cultural Treatments: Pruning has been found to increase early yields at the Winter Garden Station, because a closer spacing is then possible.

L. R. Hawthorn.

Investigations with Ornamentals

Adaptability: Continued emphasis has been given to a study of native plants for ornamental purposes, in addition to the introduction of ornamentals for adaptibility observations. During the year 175 lots of seed of native plants have been put in the seed frames or into 5-inch pots at the Main Station. Thirteen of these lots were secured in South Texas and along the Rio Grande River near Eagle Pass; one hundred thirty lots were secured on a trip into the Chisos and Davis Mountain areas of Trans-Pecos Texas and on the return trip through the Edwards Plateau. From these seed, plants of the following were secured within three months: *Canna* sp., *Schaefferia cuneifolia, Fallugia paradoxa, Leucaena greggii, Porlieria angustifolia, Parkinsonia aculeata, Helianthus* sp., *Cercocarpus parvifolius, Acacia Greggii, A. Wrightii*, four other Acacias, *Ungnadia* sp., *Nicotiana glauca, Erythina herbacea, Sapindus Drummondii, Diospyros texana, Baccharis angustifolia, Prunus virens*, an unidentified ash-like tree, *Cissus incisa, Yucca macrocarpa, Y. radiosa, Y. constricta* (?), *Hesperaloe parviflora, Leucophyllum frutescens*, 2 *Quercus sp.*, and *Cephalanthus occi-*

dentalis. About twenty lots of seed were gathered from conspicuous local annuals. Germination of these under garden conditions is being tried. In addition, late in the year, seventy-five lots of introduced seed were planted in the seed frames. Two of these, i. e., *Colutea arborescens* and *Cytisus scoparicus,* have already produced plants. Plants of eighteen additional natives have been collected for trial under cultivation.

A special collection of the rain lily group is being made for adaptability studies. The natives are well adapted and the group holds promise for the State. Among the species already in the collection are *Cooperia Drummondii, C. pedunculata, C. Traubii, Zephyranthes citrinia, Z. candida, Z. Ajax, Z. pulchella, Z. Simpsonii, Z. Treatiae,* five lots of Zephyranthes from South Texas probably representing three different species, *Habranthus texanum,* and *H. robustus.* Some of these have been obtained through the cooperation of the American Amaryllis Society.

Many of the stations include among their plantings numerous native and other species not widely grown.

S. H. Yarnell, W. S. Flory, J. C. Ratsek, and substation superintendents.

Breeding: The majority of the oleander seedlings secured from the 1936 crosses were lost in early stages, chiefly on account of the "damping-off" organism. No new crosses were made in 1937. Open pollinated seed from the 1937 crop are being given different treatments, and if a method of control for the seedling diseases is developed further, crosses will be made in 1938.

Several reciprocal crosses have been made between the copper lily *Habranthus texanum* and one of the white rain lilies, *Cooperia pedunculata.* Two sets resulted from crosses in which the copper lily was the female parent. These gave several viable appearing seed and have resulted in 5 vigorous plants.

Oak crosses, with the resulting number of acorns, are as follows: Live x Overcup, 2; Live x F_2 (Live x Overcup), 7; Live x F_1 (Live x Swamp White), 3; Live x Willow, 3. No acorns were secured from four other attempted combinations. Three hundred eighty-four sets were obtained from 1176 pollinations involving 8 combinations. Fifteen acorns resulted.

W. S. Flory.

Numerous interspecific rose crosses were made at Substation No. 2, Tyler during the past season. Over 10,000 seeds were harvested from sixty-three crosses. *Rosa gallica* was an excellent seed parent producing from over 200 to 1600 seeds for each cross, using *R. Multiflora, woodsii, saturata, rugosa, nutkana, blanda,* and *oxyodon* as pollen parents. Less than 100 seeds were obtained with *odorata* and with *foetida bicolor.* The number of pollinations varied from twenty-one to forty-six. *R. Blanda* produced over 100 seeds in all but two instances (with *foetida bicolor* and *multiflora platyphylla.* No sets were obtained with the following species as female parent:

R. Nutkana, Giraldi, Moschata nivea and *grandiflora, Mundi, Lhertieriana, Wilmottii, setipoda, oxodon,* and *odorata.*

J. C. Ratsek, S. H. Yarnell.

Propagation: New propagation trials with stem cuttings have been made with several lots of hybrid oak material. Chemical treatment prior to benching of cuttings has been made with varying concentrations of water solutions of indolebutyric acid, indolepropionic acid, indoleacetic acid, and of the commercial product Hormodin A. When treatment followed immediately after making the cuttings, results were entirely negative, no rooting, or callusing occurring. When dormant cuttings were placed in moist (not wet) sphagnum moss in an 85°F. oven, practically 100 per cent callused in from one to three weeks. When these callused cuttings were treated with plant hormone solutions some response resulted. The most effective treatment found so far is to place callused cuttings in low concentrations (five to ten units, or milligrams of crystals per 100 cc. of H_2O) of indolebutyric acid solutions for from thirty-six to seventy-two hours prior to benching in a one-half sharp sand—one-half peat moss medium. Further modification of the treatment is necessary to cause a significant percentage of the cuttings to root.

Similar trials following treatment with solutions have been run with stem cuttings of Bruce plum, Vitex, dewberry, and Governor Campbell peach. No treatment tried was effective with the peach cuttings; ten units for 48 hours was best for Vitex; and five units for either forty-eight or seventy-two hours was best for Bruce plum. Different treatments, and further trials with the same treatment are necessary before definite recommendations can be made for any of these forms.

W. S. Flory.

Cytology: The somatic chromosomes of various species and species hybrids of Quercus (Oak) are being examined. The somatic chromosomes of *Habranthus robustus* have been studied in detail and the members of the different pairs distinguished. There are six pairs varying from fourteen to twenty-two microns in length. In general the shorter the chromosome the more remote from a median position is the attachment constriction. This chromosome count, together with the reported chromosome numbers in the Zephyrantheae, gives cytological support to the conception that Hybranthus should be reinstated in generic rank, distinct from Zephyranthes.

W. S. Flory.

Rose Investigations: An account of this work on fertilizers, the relationship of plant vigor to the amount of dieback, understocks, and storage may be found in detail with the report of substation No. 2, Tyler.

J. C. Ratsek.

RANGE ANIMAL HUSBANDRY

Disease Resistance in Animals

(In cooperation with Division of Veterinary Science)

Losses from internal parasites of sheep represent one of the most important livestock problems of the southwest. There has previously been much contributory evidence pointing to the probability that the differences in susceptibility of different animals to these parasites had a hereditary basis. However, no experimental proof had been published for the inheritance of resistance to any nematodes in mammals. In order to test this question, mice were infested with the larvae of the nematode *Nippostrongylus muris.* Starting with one litter in which little immediate selection could be made, selection was made in succeeding generations for high and low resistance. By the second generation of selection and inbreeding, a highly resistant sub-line and a highly susceptible sub-line were separated out. Fecal examinations revealed an average of forty-one times as many eggs from individuals in the litter of the highly susceptible sub-line as from those in the litter of the highly resistant sub-line. The lowest egg count from the susceptible litter was fourteen times higher than the highest count from the resistant litter. Two comparable litters of mice from the next or third generation of selection were tested at a slightly greater age, and had twenty-nine times as many eggs per mouse in the highly susceptible as in the highly resistant sub-line. Again, the highest count in the resistant line was far below that of the lowest in the susceptible line, the lowest susceptible being six times as great as the highest resistant. While no individual in the resistant line has been found completely resistant, the infestation has been extremely low in some individuals. This shows definitely that resistance and susceptibility to this nematode parasite have an hereditary basis.

With a view toward a better understanding of the relationship between the constitution of an animal as represented by its hereditary make-up and a toxin-caused disease, an intensive study has been made of the effect of loin disease toxin on mice. Extreme difficulties have been encountered in this study, as it has not been found possible to maintain the toxicity of the test material at a constant level. This has necessitated very extensive and repeated assays with groups of control mice. Three stocks of mice have been used extensively in this work. In the earlier tests, one of these stocks invariably included more survivors than the other two. However, as intense inbreeding was carried further, even in the unselected controls, the differences in mortality between these stocks on test have tended to disappear.

Breeding from survivors of the more rigid of the tests has resulted in the separation of one sub-line which is definitely more resistant than the controls of the same parent stock and than a sub-line selected for susceptibility from the same parent stock, by raising offspring before injection for test.

B. L. Warwick, H. Schmidt and R. D. Turk.

Cytological and Hybridization Studies with Sheep and Goats

The cytological study of preparations from amnions of sheep, goat, and the goat x sheep hybrid embryos has been put in manuscript form by R. O. Berry and is practically ready for publication.

One of the wild species which is usually classified by systematic zoologists as a species of wild sheep is the Barbary sheep, *(Ovis tragelophus* or *Ammotragus lervia).* These animals lack the infra-orbital glands which are typically present in sheep and typically absent from goats. An attempt was made to cross males of this species with domestic sheep. Through the cooperation of Doctor C. R. Schroeder, pathologist, and Mrs. Belle J. Benchley, executive secretary, of the San Diego Zoological Park, five domestic ewes were pastured with two young vigorous Barbary rams throughout the fall breeding season. Caretakers thought that matings took place, but none of the ewes became pregnant. One Barbary ram was also purchased and used by the Texas Agricultural Experiment Station at College Station in an attempt to cross him with both sheep and goats. Ten different domestic ewes were placed in the same pen with the Barbary ram for different periods of time during the fall breeding season, usually when they were definitely known to be in estrum. No matings were observed. Because it was extremely doubtful whether this ram under the existing conditions attempted any natural matings, semen was collected from him by the electric stimulation method as described by Gunn in Australia. The semen from the Barbary ram was used to inseminate seven domestic ewes and nineteen female domestic goats. Three of the goats were inseminated at two different estrus periods. All of the sheep and all except one of the goats came in heat at the next period of about the usual time of seventeen days for sheep and twenty-one for goats. One domestic goat gave birth to a still-born, female hybrid offspring 152 days after insemination. This tends to confirm the validity of considering this species to be in a different genus from either sheep or goats.

B. L. Warwick.

Inheritance of Polled Character in Fine Wool Sheep

Two more rams have been identified by breeding test as being homozygous or pure breeding for the polled pair of genes. One of these, a son of the first homozygous ram identified, was raised and tested by a cooperating Rambouillet breeder, and the ram was also found to be free from the recessive gene for black which has been "contaminating" this stock as well as many other lines of Rambouillet breeding. More sires are being tested to find polled rams which are free from the recessive gene for the cryptorchidism or ridgling character.

B. L. Warwick, J. M. Jones, W. H. Dameron,
and P. B. Dunkle.

Inheritance of the Ridgling Characteristic in Goats

Twenty normal male progeny in the 1937 Registered Angora kid crop from one normal stud buck brings his total male progeny up to sixty-three, all normal. During the last four seasons in the flock of does to which he was bred, ten per cent of the male kids have been ridglings. If the progeny of this buck are excluded, 15 per cent of the buck kids were ridglings during the four-year period. Also, the does bred to this buck for the 1937 kid crop included all of the previously known mothers of ridglings except one. While this makes it practically certain that this buck is homozygous for the two pairs of genes concerned, he is being tested further by breeding to a group of does sired by ridglings to kid in 1938.

Intensive selection based on breeding tests of the progeny of this buck as well as more extensive testing should make it possible to identify more bucks free from the undesirable recessive genes for ridgling. More normal Angora bucks are being tested.

B. L. Warwick.

Inheritance of Skin Folds on Rambouillet Sheep

(In cooperation with Bureau of Animal Industry, U. S. Department of Agriculture)

The fine wool breeds have predominated on the sheep ranges in Texas since the inception of the industry in this state. Merinos, which are generally regarded as premier producers of fine wool, were at the height of their popularity during the period when the industry was on a wool basis. However, the Texas range sheep industry has in more recent years been transformed to a mutton and wool basis and the Rambouillet, owing to its larger size and more desirable mutton qualities, has come into rather prominent favor among range producers and has to a large extent replaced the Merino. The increased desirability of smooth-bodied lambs for feeder purposes as contrasted with the more wrinkly types, which seem more susceptible to blow fly "strikes", has served to stimulate interest in the smooth-bodied type of Rambouillet. The wrinkly types usually shear more unscoured wool; however, comparison of the two types at this Station over a period of years has shown conclusively that the wrinkly types excel only in unscoured wool. The two types do not differ significantly in weight of clean wool or average diameter of fiber. The smooth type produces a longer staple and has more uniformity of fiber fineness. These results were obtained in a flock where both B and C types are being produced from somewhat similar breeding. Many of the animals have one or both parents of different type from the offspring, indicating that some segregation and recombination of genes is taking place. On the other hand, selection for lack of wrinkles by ranchmen has sometimes been followed by a reduction in wool production. This is probably due to several things, selection for one thing to the almost complete exclusion of other points probably being the most important. For this reason, it is highly important to know more about the inheritance of skin folds. Such information would be directly useful in selecting smooth strains which would breed true for smoothness while still carrying acceptable production.

Besides study of segregation in matings of pure-bred Rambouillets, matings have been made of one heavy C type and one B type Rambouillet ram x Corriedale ewes (free from wrinkles). The F_1 progeny have been raised and examined after the first fleeces were removed. In addition to the seven reported last year, thirteen more have been studied. In every case the number and size of the skin folds was smaller than recorded for the sire when his first fleece was removed. Three individuals came closer to their sire in this respect than did any of the seven reported last year. Compared with their sire as 100, they ranged from 1 to 68 in values, with only the one individual with 68 having a value above 50. Only five out of the twenty for the two years had values above 20. This indicates that there is some dominance of the genes for freedom from skin folds. More F_1 progeny are needed as well as back-cross and F_2 progeny before the number of pairs of genes may be estimated. The above results point to the possibility that the number of genes may be relatively small.

J. M. Jones, B. L. Warwick, W. H. Dameron,
S. P. Davis, H. C. McPhee, D. A. Spencer.

Inheritance of Fiber Characteristics in Rambouillet and Romney Sheep and Their Crosses

This project has been started and has for its primary purpose the study of the inheritance of staple length together with the transference of some additional staple length to the Rambouillet breed from the Romney. A small group of fourteen registered Romney ewes, two stud Romney rams, and fifty-one Rambouillet range ewes are being used as breeding material. The initial matings have been made.

B. L. Warwick, S. P. Davis.

Inheritance of Type in Angora Goats

The progeny of nine stud Angora bucks used in the Station flock have been compared on the basis of fineness of fiber quality. Two of these sires were of strictly flat lock type. The others were either strictly or predominantly ringlet type. When these sires are rated on the relative fineness of the fiber of their progeny, the one with the finest fibered progeny was ringlet type. The two flat lock sires rated as third and fifth in this list of sires, which indicates that the quality of the fiber is not directly dependent on the type of lock.

The progeny of these two flat lock sires produced heavier shrinking fleeces than did the progeny of the ringlet type. The progeny of one of the flat lock bucks sheared the most pounds of unscoured mohair. However, after the fleeces were scoured, his rank dropped to fifth place. The progeny of the other flat lock buck produced scoured fleeces which averaged only slightly above the average of the flock.

The work thus far would point to the probability that type of lock has little if any effect on quality or quantity of scoured mohair. Heavier shrinkage apparently is associated with the flat lock type of mohair fleece.

It is of interest to compare the shrinkage of mohair with typical fine wool produced on the same ranges. Only very few mohair fleeces in this study had a shrinkage of more than 25 per cent, while, on the other hand, Rambouillet wool produced on the same range practically always had a shrinkage of more than 55 per cent. Accordingly, even though Rambouillets produce more unscoured wool per animal than Angora goats produce unscoured mohair, the production of clean fiber is at least 25 per cent greater per animal for well bred Angora goats than for comparably bred Rambouillet sheep. This statement holds true in spite of the smaller size of the Angora goat.

J. M. Jones, B. L. Warwick, W. H. Dameron, S. P. Davis.

Relation of Age of Animal to Fineness of Wool and Mohair

Analysis of data from a large number of Rambouillet wool samples from the Ranch Station has been brought up to date and is practically ready for publication, along similar lines to that previously published for mohair in Bulletin No. 516.

J. M. Jones, B. L. Warwick, S. P. Davis, W. H. Dameron.

A Study of the Adaptation of the Corriedale Sheep to Southwest Texas Conditions

This project has been closed. The data are practically ready for publication.

J. M. Jones, B. L. Warwick, W. H. Dameron,
D. A. Spencer, S. P. Davis.

Mineral Requirements of Cattle in the East Texas Region

Substation No. 2, Tyler, Texas

The forty Hereford steer calves used in the test were received on the Station January 25, 1936, at an average weight of 415 pounds. They were sold December 7, 1937, at Fort Worth at an average weight of 935 pounds. Purchased on the Fort Worth market @ $7.25 per hundred weight and with death loss of two head, the average cost per head delivered to the Station was $33.71. Selling at $6.65 per hundred weight, returns per head less marketing cost were $58.48. Total feeds supplied during the two periods of winter feeding, January 25 to March 30, 1936, and November 18, 1936 to April 6, 1937, and a drylot fattening period September 22 to December 6, cost approximately $25.00 per head. The enterprise entailed a loss for the Station in that no returns were received for pasturage and labor.

On March 30, 1936, the steers were divided as equally as possible into four groups of ten head each, average weight 443 pounds. These groups were maintained until the steers were marketed. All groups received similar handling except that different salt licks were supplied to each group. Group 1 received finely granulated salt only as a lick. Group 2 received salt only, except for a brief period in April 1936, until April 7, 1937, after which they were supplied a mixture of 70% salt and 30% dicalcium phosphate. The dicalcium phosphate was supplied by the T. V. A. and was guaranteed to contain less than 0.20% fluorine, with P_2O_5 content of 40.18%. Group 3 received a salt lick consisting of one part salt and two parts feeding bone meal, while the salt lick supplied to Group 4 consisted of two parts salt, one part pulverized oyster shell, one part bone meal, and one part cottonseed meal.

The average consumption of salt per head daily for 583 days was 0.41 ounce, 0.26 ounce, 0.31 ounce, and 0.38 ounce for the respective lots. Salt consumption was lower during the second grazing period, 1937, than for the first grazing period, 1936. Group 2 consumed less salt than any other group, but this was not particularly noticeable until dicalcium phosphate was added in April, 1937, after which the steers consumed only 0.18 ounce salt and 0.07 ounce of the dicalcium phosphate daily.

The respective gains from March 31, 1936 to September 22, 1937, during which time the steers had been fed for maintenance only, were 342, 369, 342, and 371 pounds per head. The low gain for Group 3 can be explained by two inferior steers included in this group; however, the gain made by Group 2 cannot be ascribed to benefit resulting from the feeding of dicalcium phosphate, for this group had shown to advantage before being supplied with this supplement and consumed only a very negligible amount.

Gains from grazing were small for 1936, averaging 156 pounds for the forty head, for the period March 31 to November 18, 1936, the greatest weight being attained on October 14. Gains for 1937 were more satisfactory, averaging 208 pounds for the period April 7 to September 22, 1937. The net gain from March 31, 1936 to April 7, 1937, was only 138 pounds per head, since an average loss of 18 pounds per head occurred during the wintering period, November 18, 1936 to April 7, 1937, despite the supplementary feeding of 1.78 pounds cottonseed cake, 5.88 pounds sorgo silage, and 1.86 pounds hay per head daily.

It is tentatively concluded that no material benefit results from the supply of mineral supplements by the medium of salt licks to grazing steers in this area. Under favorable price conditions, the grazing of beef steers and subsequent feeding for fattening may be profitable in the area.

J. H. Jones, P. R. Johnson, J. M. Jones.

Dried Citrus Peel and Pulp Meal in Cattle Fattening Rations

Substation No. 1, Beeville, Texas

The estimated tonnage of undried citrus pulp (which consists of the rind, flesh, and seeds of grapefruit and oranges) in South Texas in 1937 was 100,000 tons. The wet mass has a moisture content of approximately 80 per cent; however, on a dried basis, it contains about 12 per cent moisture. The handling of this citrus by-product has become an economic burden upon the citrus fruit growers in the Rio Grande Valley, since regulations require its burial in instances where it is not processed.

Investigations at the California Experiment Station have indicated that dried citrus peel and pulp is a satisfactory feed for dairy cows, having a value for milk production approximately equivalent to that of dried beet pulp. According to results of investigations at the Colorado Experiment Station, dried molasses beet pulp had a feeding value of approximately 78 per cent of that of shelled corn when fed as the only carbohydrate concentrate to fattening lambs. When it was fed mixed with equal parts by weight with shelled corn at the Colorado Experiment Station, the beet pulp was found to be practically equal to shelled corn in feeding value.

It was with the thought of rendering a service to the citrus fruit producers in South Texas that a test has recently been placed under way at the Beeville Station in an endeavor to determine the feeding value of dried citrus peel and pulp meal in the rations of fattening beef cattle. Twenty-four steer yearlings used in this test were divided into three equal groups of eight head each on December 9, 1937, and placed on fattening rations. Lot 1 (check) is being fed ground ear corn, shuck included; in Lot 2, dried citrus peel and pulp meal replace 25 per cent of the ground ear corn; while in Lot 3, it is planned to replace 50 per cent of the ground ear corn with dried citrus peel and pulp meal. Cottonseed meal is being fed at the same level to all three lots. Roughages in the form of hegari silage and cottonseed hulls are being fed at the same levels in each of the three lots.

A fourth lot of similar cattle from the same herd and comparable to Lot 1 is being fed a similar ration except that in Lot 4 finely ground rice hulls have replaced the cottonseed hulls fed to the check group, with a view of determining the feeding value of the ground rice hulls. Since finely ground rice hulls are at the present time being used as an adulterant in certain mixed feeds, this test may indicate whether the inclusion of this product in the ration may tend to retard gains.

J. M. Jones, J. H. Jones, R. A. Hall.

Fattening Steers in the Madera Valley

Substation No. 9, Balmorhea, Texas

This experiment included (1) a study of method of using a large amount of roughage feeds and limited concentrate feeds in finishing yearling steers, (2) a test for the most desirable combination of hegari fodder and alfalfa hay under the above conditions, and (3) a comparison between self-feeding and hand-feeding.

Each of the six lots of ten (one steer died in Lot 6) 721-pound Hereford yearling steers was fed an average daily ration of 1.48 pounds of cottonseed meal, 2.44 pounds ground milo heads, 1.96 pounds of cottonseed for 196 days. The respective lots in order were fed 2, 3, 4, 4, 5, and 6 pounds of ground alfalfa hay, Lot 3 being self-fed. The ground hegari fodder was fed according to appetite, the respective lots consuming an average of 16.5, 14.8, 14.9, 14.6, 13.5 and 11.7 pounds per head daily.

The trial demonstrated that fleshy yearling feeder steers can be finished in 196 days on rations containing large amounts of roughage feeds. The dressed yield of 64.8 per cent, basis market and hot carcass weights, was indicative of the high finish obtained. However, average gains were lower, 1.96 and 1.55 pounds daily basis feedlot and market weights, than would be expected from rations high in concentrates; and carcass grades were lower than expected from the outward appearance of the steers.

It was indicated that two pounds, and the most, six pounds of alfalfa, were the least desirable amounts because of slightly lower gain and selling price. The results from feeding three, four, and five pounds of alfalfa were practically equal.

Self-feeding had the advantage of hand feeding, even without allowing for any possible saving in labor, in that self-fed steers returned heavier carcasses of more desirable grade.

J. H. Jones, J. J. Bayles, J. M. Jones.

Mineral and Protein Deficiencies in the East Texas Forest Region

East Texas Pasture Investigations, Lufkin, Texas

The well-bred Hereford heifer calves placed on the Station December, 1934, were bred in June, 1936, and calved during the spring and summer of 1937. The inventory to date (January 1, 1938) shows one four-year-old bull, twenty-six cows coming fours, ten bull calves, six heifer calves, and one steer calf. One cow died during July and one bull calf was sold.

Each cow except one became pregnant, two calves died as result of dipping, five died quite early, one cow aborted, and eighteen calves were raised. Systematic dipping for tick eradication began May 12, being continued at intervals of two weeks as late as August 18.

The calving records of the five groups of five heifers which received different minerals—iron, cobalt, copper, bone meal, and check—by daily drenching from February 26, 1936, to November 4, 1936, were four, three, four, five, and none living calves to date of April 19, 1937. This calving record with no early calves in check lot and coupled with the fact that the group receiving copper had made greater gain, 42 pounds per head, for the period in which drenching was done indicated that copper and bone meal might have value. Groups of five, however, were too small, so that cows with calves were divided into two groups of eight cows and calves each. Beginning April 28, Group 1 cows were force-fed three ounces bone meal six days per week, and Group 2 was force-fed three ounces bone meal and copper at the rate of 2.083 milligrams per hundred weight daily.

At the close of this test period, September 28, Group 1 cows, starting at an average weight of 907 pounds on April 28, weighed 885 pounds, the respective weights for Group 2 cows being 902 and 879. The weights of calves for the respective groups were 146 and 363, and 135 and 362. Hence, no apparent benefit accrued from the dosage of copper.

The calves which were weaned September 28 and since have been creep-fed exceeded 460 pounds weight. The bull calves are to be kept on the Station until the fall of 1938 or the spring of 1939, when they will be sold for breeding purposes.

Pasturage conditions were exceptionally good during the spring and early summer. The forty-acre improved pasture provided an abundance of grazing and some six tons of hay were harvested from the area. Some supplementary feeding was necessitated during the fall, and heavy feedings will be necessary during the winter to avoid such weight losses as for 1936-37, when the herd averaged a loss of 127 pounds per head from November 4, 1936, to January 27, 1937.

J. H. Jones, E. K. Crouch, R. H. Hensel,
E B. Reynolds, J. M. Jones.

A Study of Native and Improved Pastures in the Gulf Coast Prairie of Texas

Substation No. 3, Angleton, Texas

The steers which were received April 19, 1934, as 485 pound yearlings were marketed during 1937. Lot 2, seven steers grazed on 17½ acres of unimproved native pasture, were marketed June 16, 1937, at $6.35 per hundred weight, average weight 843 pounds. Lot 1, seven steers grazed on 17½ acres of pasturage planted to improved grasses, were marketed November 17, 1937, at $6.25 per hundred weight, average weight 1010 pounds. Lot 2 steers were grazed 1154 days, making an average total gain of 358 pounds per head, or 0.31 pounds daily, and Lot 1 steers were grazed 1305 days with a total gain of 525 pounds per head and 0.40 pound daily.

Lot 2 steers sold on June's high market, Lot 1 in November with the market approximately $2.00 per hundred weight lower. Carcass grades for Lot 2 were no better than "low medium," while carcasses for Lot 1 should have classed as medium grass steers.

Lot 2 steers were marketed at the period when previous observations have indicated that cattle on such native pasturage reach optimum weight and fatness. Lot 1 was marketed with excessive shrinkage (two days in stockyards at Houston before weighing) and perhaps attained maximum weight and fatness two to four weeks before November 17.

It is believed that the chief factor causing increased production from improved pastures was the greater yield of grazing over a longer period. Steers on improved pasture received no supplementary feed, and some hay (mostly Carpet grass) was harvested from the area upon which they were grazed. Steers on unimproved native pasture were fed 2930 pounds of prairie hay during the winter of 1934-35 and may have received some hay in succeeding winters. The native pasture (mostly Little Bluestem), while overstocked in comparison to the improved pasture, apparently produced more rapid early gains than improved pasture. The improved pasture was later in getting started but furnished more grazing of greater desirability through the summer and fall. It is indicated from the performance of these steers that a pasture management program should provide an area of native pasturage for late winter and early spring and an area of improved grasses for summer and fall.

J. H. Jones, R. H. Stansel, J. M. Jones.

Beef Cattle Feeding Investigations Relating to Mineral Deficiency Studies in Range Beef Cattle Production

(In cooperation with Divisions of Chemistry and Veterinary Science,
and Bureau of Animal Industry, United States
Department of Agriculture)

A survey of the South Texas grazing area, visits to ranch operators, and collection and analyses of grass samples were continued during the year. Many samples of forage plants have been collected, with partial analyses having been made on 611 samples, and complete analyses for chemical composition, including mineral content, having been made on 129 samples.

Analyses of forage samples collected from cattle ranges in these areas have shown that the protein and phosphorus content is greatest in the early growth stages and gradually decreases as the grass matures, the low point being reached during the dormant period in winter. This preliminary study has indicated a deficiency of phosphorus and a sufficiency of calcium on most of the soils of the area thus far studied.

The King Ranch has recently entered into an agreement with these agencies whereby a range feeding trial near the old Lassiter headquarters, approximately 20 miles south of Falfurrias, will further test the nature of the mineral deficiencies and seek to develop methods of supplying the proper mineral balance to range cattle.

J. M. Jones, J. H. Jones, W. H. Black, L. H. Tash.

Feeding Problems Affecting Beef Production

U. S. Experiment Station, Big Spring, Texas

(In cooperation with the Bureau of Animal Industry, United States Department of Agriculture)

The 196-day feeding test conducted during 1936-37 with forty good to choice Hereford steer calves, initial weight 426 pounds, was a repetition of previous work to determine the efficiency of feed utilization by feeder steer calves, fed singly and in groups (1) when full-fed and (2) when fed limited rations. This work has included and still includes a study of the relationship of type and individuality of steers to rate and economy of gains.

The interpretation of results is to be based both on feedlot performance and on the physical and chemical composition of representative rib-cuts from steers individually fed, Lot 1 full-fed, and Lot 2 on limited feed. The Division of Rural Home Research is cooperating in this study according to the general project on cooperative meat investigations.

The steers fed individually were slightly more efficient in utilization of feed than steers fed in groups (ten head in each comparative group) whether on full feed or limited rations, making slightly greater gain, cheaper gain, and greater profit. Group-fed steers maintained better appetites with less fluctuation in amount of feed consumed than steers individually fed.

Efficiency of feed utilization and gain varied greatly between individuals and while data as to the relationship of type and individuality of steers to rate and economy of gains have not been analyzed, it becomes increasingly evident that performance of individuals is difficult to predict between feeder calves of essentially the same breeding, age, and initial weight.

The lots fed limited rations received approximately 16 per cent less milo heads, 16 per cent less cottonseed meal, and 10 per cent less Sumac fodder than the full-fed lots, and made approximately 10 per cent less gain. Limited rations made lower costing gains but produced less finish, a lower selling price, and returned less profit. The lower selling price for limited-fed steers seemed to be justified by lack of finish; however, the lack of finish was not shown in carcass grading. The beef grader explained that the full-fed lots produced top carcasses in the various grades, while those from the limited-fed lots barely qualified within the grades. The physical and chemical composition of the rib cuts also indicate that the full-fed lots had slightly greater finish. In regard to physical composition, rib cuts from full-fed steers contained a lower percentage of lean and bone but a greater percentage of fat and edible portion. Chemically they contained a lower percentage of protein and water but a higher percentage of ether extract.

J. M. Jones, F. E. Keating, J. H. Jones, Sylvia Cover.

Vitamin A Requirements for Beef Cattle and Sheep

Substation No. 7, Spur, Texas

(In cooperation with Divisions of Chemistry and Veterinary Science,
and Bureau of Animal Industry, United States
Department of Agriculture)

Fifty good to choice Hereford steer calves were received from the SMS Ranch, Spur, Texas, and started on a ration of cottonseed meal and cottonseed hulls November 19, 1936. They averaged 516 pounds December 9, when ten average calves, identified as Group 5, were started on 800 micrograms of carotene, supplied by ground alfalfa hay, per hundredweight liveweight daily in addition to the common full-fed depletion ration of 10% cottonseed meal, 3% digester tankage, 87% cottonseed hulls, and 0.10 pound limestone flour. The remaining forty were brought to depletion as indicated by two observations for first or second degree night-blindness. (In previous experiments the steers were fed until at least two observations for third degree night-blindness were obtained.)

Group 1 consisted of the first ten steers to become depleted. Groups 2, 3 and 4 were formed by alternate placement of individuals as they were depleted. The respective carotene levels supplied were 450, 600, 750, and 1000.

When depleted, each steer was placed in an individual pen, supplied the designated level of carotene, and started on a fattening ration which did not exceed 15% cottonseed meal, 3% tankage, 30% white grain, and 52% cottonseed hulls.

The average number of days required for depletion were 105, 143, 146, 149 in order for Groups 1, 2, 3, and 4. One steer in Group 5 had affected night-vision after 134 days and five of the nine remaining in the group had sufficiently affected night-vision after 197 days to have been termed depleted.

Daily gains in pounds prior to depletion averaged 2.00, 1.95, 1.84, and 1.84; after depletion 1.65, 1.46, 1.60, and 1.77; and for the entire period of the test 1.85, 1.72, 1.75, and 1.79 in respective order for the Groups

1, 2, 3 and 4. Group 5, receiving 800 micrograms carotene from the outset had an average daily gain for the entire period of 1.84 pounds.

None of the carotene levels supplied after depletion were effective in preventing an increase in degree of affected night-vision; however, the degree of affected night-vision was lessened with higher levels of carotene. For instance, Group 3 was affected to a lesser degree than Group 2, and Group 4 to a lesser degree than Group 3.

Five steers from Group 1 were transferred from Spur to the Division of Veterinary Science, College Station, on May 11, 1937. Two of the five died some months later, but three remain alive and are very fat, January 8, 1938, although the carotene level (450 micrograms) and ration have been unchanged.

Carotene values (determinations by the Division of Chemistry) were markedly higher for ground alfalfa hay during the year than for 1935-36, which increase in carotene content cannot be explained from any different method of harvesting and storing for the two different years.

A condition of marked swellings, mostly in the hock regions, was noted among the steers, which condition was manifested to only very slight degree in previous tests. This condition of swellings caused some concern as to the marketability of steers so affected. Accordingly, the first steers marketed (August 26) were the ones about which there was little question. The suspicious ones were held for a period of restorative treatment (large amounts of alfalfa hay, green alfalfa, cod-liver oil), with others less well finished being marketed September 20. No steers were found unfit for slaughter, although some had marked swellings. Except for a few individuals, all were highly fattened, market-topping steers, selling for $12.50 per hundredweight on August 26 and $13.00 on September 20.

The Division of Veterinary Science collected eyes and brains from a number of steers but no liver samples were desired by the Division of Chemistry.

It is indicated that levels of 800 to 1000 micrograms are definitely too low to prevent affected night-vision. However, the majority of steers received 800 micrograms of carotene from the outset and 1000 micrograms after depletion period without evincing any very serious symptoms of vitamin A deficiency. A level of 2000 micrograms of carotene supplied to a group toward the close of the test, although fed only a short time, was definitely restorative.

J. H. Jones, R. E. Dickson, J. M. Jones.

Fattening Yearling Steers on Silage, Cottonseed Meal and Cottonseed Oil

Substation No. 7, Spur, Texas

This work for 1936-37 was a repetition of the test conducted November 14, 1935, to May 8, 1936, but under different conditions. The short feeding period of 122 days was necessitated by lack of roughage feeds. In the first test approximately 42 per cent of the silage fed was hegari, the remainder red top sorghum, but in this test all the silage was red top and more dry roughage was fed. The steers did not reach high finish, only the better ones being top medium grade, while in the first test a number were of choice grade. There was slight difference in daily gain on basis of feedlot weights, but on basis of market weights the long-fed steers showed .33 pound average greater daily gain and 2.11 per cent greater dressing percentage.

Greater initial weight, 743 pounds as compared to 676 pounds for the first test, a preliminary feeding period of approximately thirty days on cottonseed meal and silage, and use of a greater percentage of dry roughage perhaps combined to reduce looseness so that the condition was never excessive. It was again apparent that .58 and .98 pound cottonseed oil plus 4 pounds of cottonseed meal in the ration had less effect than either 5.32 or 6.85 pounds of cottonseed meal. According to the time required for each lot to consume their feeds, it was indicated that the rations containing the larger amounts of cottonseed meal were more palatable than those containing the larger amounts of cottonseed oil.

The results from feeding cottonseed oil were clearly less favorable than in the first test. Lot 1, fed 3.97 pounds cottonseed meal and 0.18 pound cottonseed oil, received the least productive energy, made the least gain, and were inferior in finish to all other lots except Lot 4, which received 0.57 pound cottonseed oil; yet, on basis of both feedlot and market weights they made the most efficient gain. Lot 2 received 1.36 pounds more cottonseed meal and 0.48 pound less cottonseed oil than Lot 4, but the calculated productive value of their rations were practically equal. The lots returned carcasses of equal weight, but Lot 2 had considerable advantage in finish. Likewise, Lots 3 and 5 received rations practically equal in calculated productive value, but Lot 3, receiving 6.85 pounds cottonseed meal as compared to 3.95 pounds cottonseed meal and 0.96 pound cottonseed oil, made greater gain and had slightly more finish. In both tests, lots receiving the larger amounts of cottonseed meal (Lots 2 and 3) have had more finish than Lots 4 and 5, receiving the larger amounts of cottonseed oil.

As in the first trial, all factors considered—gain, cost of gain, efficiency of rations, marketability of steers, and profit—the mid-amount of cottonseed meal, 5.32 pounds, as fed to Lot 2, made the best return.

J. H. Jones, R. E. Dickson, J. M. Jones.

Feeding Tests with Cottonseed Meal and Mixtures of Cottonseed Meal, Salt, and Lime (CaC_3)

Substation No. 14, Sonora, Texas

Various feeding tests were conducted at the Ranch Experiment Station (Substation No. 14) to provide information on control of bitterweed trouble on the range. Straight cottonseed meal and mixtures of cottonseed meal, salt, and pulverized oyster shell were supplied in self-feeders to both ewes and lambs.

In one fifty-four-day test 174 lambs were self-fed a mixture of 100 pounds cottonseed meal, ten pounds pulverized oyster shell, and ten pounds salt, while running on a 460-acre pasture which provided an abundance of old grass, oak browse, and young bitterweed plants. Feed consumption ranged from 3.80 ounce per head daily for the first eleven days to 16.17 ounce for the fourth period of feeding, January 31 to February 9 inclusive. Bitterweed trouble was not prevented in that twenty-three lambs were found sick from bitterweed and four were found dead. During the fourth period mentioned above, a few lambs showed symptoms of overeating but all recovered. Lambs self-fed on straight cottonseed meal after the cottonseed meal and salt feeding test for twelve days consumed 13.35 ounces daily without any ill effects.

Bred ewes self-fed a mixture of 100 pounds cottonseed meal, ten pounds salt, and ten pounds oyster shell for twenty-five days on bitterweed range consumed an average of 8.37 ounces daily but this feeding failed to prevent trouble from bitterweed. Eighty per cent of the ewes showing bitterweed poisoning also showed "mealy" heads.

Ten ewes with five-months-old lambs were self-fed a mixture of 100 pounds cottonseed meal and five pounds oyster shell August 12 to September 22, 1937, with an adequate amount of dry grass and oak browse for grazing. Both ewes and lambs consumed an amazing amount of the mixture. The average daily consumption for ewe with lamb for the first eleven days was 1.43 pounds and for the last nine days 2.92 pounds. Despite the large amount of cottonseed meal consumed during the hot weather and with dry range, all animals remained in vigorous thrifty condition. Present information in regard to feeding of cottonseed meal and salt mixtures is inadequate.

W. H. Dameron, J. M. Jones, J. H. Jones.

Effect of Degree of Fatness on Tenderness and Flavor in Lamb

Forty-eight comparatively smooth-bodied, range-raised wether Rambouillet feeder lambs, which graded "low medium" as feeders at the time of purchase, were purchased in September, 1937, and are being used in this year's study of the effect of the degree of fatness on tenderness and flavor of lamb. Eight representative lambs were slaughtered previously to their being placed on feed. The remaining forty were full fed a concentrate mixture of nine parts yellow shelled corn and one part cottonseed meal. Alfalfa hay supplied the roughage portion of the ration. After being on feed in dry lot for six weeks, eight representative lambs were slaughtered for use in the physical and chemical study of the short rack and leg of each lamb. Eight representative lambs were slaughtered at two-week intervals. All carcasses are graded by a committee from the Animal Husbandry staffs of the Experiment Station, College, and Extension Service. The meat phase of this study, which is being conducted by the Division of Rural Home Research, is reported under that Division.

Sylvia Cover, A. K. Mackey, C. E. Murphey.

Determining Grades and Shrinkages of Texas Wool and Mohair

The service of determining the grades and shrinkages of Texas wool and mohair for producers which has been rendered since the establishment of the wool scouring plant in 1921, has been continued during the current year.

These routine determinations have been made by scouring not less than twenty-five fleeces taken at random from the flock. The accuracy of this was established previously and found to be reasonably close enough for most needs. However, if whole fleeces had been used, it would have been necessary to have had at least 100 fleeces to insure results within 1 per cent above or below the true average in 95 out of 100 cases. Because of the large bulk when 100 or more fleeces are scoured as well as the added expense and inconvenience to the grower, these larger lots of fleeces have rarely been used. For these reasons, it has seemed highly desirable to find whether the shrinkage of a clip could be determined as well from a relatively small amount of wool obtained by taking a handful from each fleece of a random group of sheep at shearing. In order to obtain basic data for the study of this question the fleeces of 18 B type and 181 C type ewes from the Ranch Experiment Station Rambouillet sheep were used in 1937. One handful from the shoulder of each sheep was bagged and scoured separately from the rest of the fleece. It was found that there was a high degree of correlation between the shrinkage of the sample and the shrinkage of the whole fleece. After allowing for the effect of differences in size of shoulder sample, the coefficient of correlation between the shrinkage of the shoulder sample and the whole fleece was found to be +.9443. Based on this, it was found that it would be necessary to have wool obtained from approximately 26 per cent more sheep when the shoulder samples were combined than would be the case where a number of whole fleeces were scoured together. If the results of this one year's study can be confirmed by further work, it will be possible to obtain results comparable to those previously obtained with units of twenty-five whole fleeces by using a handful of wool from the shoulder of each of thirty-two sheep scoured as one unit. On the basis of the amount of variability found in this representative flock this year together with the correlation mentioned above, it was found that 197 shoulder samples were needed to give a shrinkage figure within 1 per cent above or below the true shrinkage of a particular clip. Based on the same variability, it would require 157 whole fleeces to obtain results of the same accuracy. With these figures, there are only three chances out of 1000 of being outside the limits stated. By reducing the odds to less than 1 in 1000 of being outside the stated limits, we should require for the same results 238 shoulder samples weighed together, or 190 whole fleeces. As these results are based on data from only one season and only 199 fleeces, further work will be necessary definitely to establish the number of samples necessary.

In addition to the above study, a comparison was made of the shrinkage per cent of twenty-five whole fleeces and the corresponding handful of wool from each of these sheep. This work was cooperative with the Livestock, Meats, and Wool Division of the Bureau of Agricultural Economics, and the Texas Extension Service. The shoulder samples from the twenty-five head were scoured as a unit, as were the twenty-five fleeces. The combined shoulder samples of the unit weighed from five to twelve pounds. Thirty-six comparisons were made, and here again a high degree of correlation was found between the shrinkage of the shoulder samples and the shrinkage of the whole fleece.

Using the formula derived from the study of individual fleeces from the Ranch Experiment Station discussed above, the shrinkage of each lot of wool was calculated from the shrinkage of the shoulder samples. These shrinkage percentages were compared with the shrinkages actually obtained by scouring the whole fleeces. The shrinkages calculated in this way were very close to the actual shrinkages. Among the thirty-six comparisons, there were only six cases where the difference was greater than 2 per cent. Of course, this is based on samples of only twenty-five fleeces and shoulder samples from the same sheep. Larger numbers of fleeces should give even closer results.

During the year, 22,629 pounds of wool and 611 pounds of mohair were graded and scoured at the wool scouring plant. All mohair scoured was from the flock of Angora goats owned by the Ranch Experiment Station.

Ranch Experiment Station Rambouillet ewes fleeces had a shrinkage of 59.1 per cent; the Corriedale ewes wool had a shrinkage of 50.2 per cent; and wool from the ewes of Rambouillet x Corriedale cross had a shrinkage of 53.3 per cent. Fine wools from the Animal Husbandry Department, A. & M. College of Texas, had a shrinkage of 64.1 per cent. Fine wool from the Texas Technological College had a shrinkage of 72.6 per cent. Registered Rambouillet ewe fleeces from the Iowa Park Station had a shrinkage of 68.1 per cent.

Mohair from the registered Angora bucks at the Ranch Station in the fall of 1936 shrank 16.3 per cent in scouring; spring 1937, 15.1 per cent; and fall 1937, 16.8 per cent. The registered Angora does from the Station had shrinkages of 14.8 per cent in fall 1936; 18.9 per cent in spring 1937; and 13.2 per cent fall 1937.

S. P. Davis, J. M. Jones, B. L. Warwick.

ENTOMOLOGY

Biology, Control, and Taxonomy of White Grubs *(Phyllophaga)* in Texas

About forty-four species and three varieties of *Phyllophaga* are known to occur in the State, and hitherto the biology of none of these has been investigated under Texas conditions. Details of the life history of the more economically important forms are essential in the development of practical control measures. The immature stages develop within the soil; the rate of growth is slow, so that at least one year, sometimes more, is required for completion of a generation.

Preliminary biological studies were begun in the spring to devise a satisfactory oviposition cage and to develop suitable methods for rearing the grubs under local conditions. Flower pots filled with moist soil and covered with a glass globe proved quite satisfactory for securing oviposition. The eggs were successfully incubated by confining them in 8-ounce tin ointment boxes partially filled with moist sterile sand. A number of different kinds of containers were used in attempts to rear the larvae. Also, efforts were made to determine the best type of soil media and food for developing grubs. The comparative tests have not yet been completed and these questions as to the best rearing technique remain unanswered.

Among the twenty-one species of beetles confined in oviposition cages all but two or three laid eggs in sufficient numbers for rearing observations. Hot, dry weather during the summer months and incomplete information with respect to rearing methods adapted to local conditions resulted in an extremely high rate of mortality among all young grubs which were hatched from eggs. However, about 250 individuals were successful carried through the critical first instar period and are now passing the winter in an apparently quiescent state. Most of the younger grubs ceased feeding by November 1, but about fifty nearly grown field-collected individuals, which were caged for observation, showed feeding activities up to December 1. It appears likely that the larger grubs will continue to feed during periods of mild temperatures throughout the winter. Sprouted kernels of corn and grain sorghum were used in most cases as food for the developing larvae.

The preliminary records indicate that the incubation period of the egg ranges from seventeen to twenty-three days and that approximately a month is required to complete development in each of the first two instars. None of the larvae attained full growth by the end of the year, and hence there are no records available on pupation or the duration of the pupal stage in the reared material under observation. It appears likely that larvae in the first instar as well as the two following ones will pass the winter successfully at least in cages kept in the laboratory.

Larvae of an undetermined species caused extensive injury to wheat in Hardeman County. On October 20, the reported infestations ranged from ten to twenty grubs per square foot and the stand of wheat in one 200-acre field was completely destroyed. Commercial crops of garlic in Fayette County also suffered serious injury from attack by white grubs. Records in one field indicate that 60 per cent of the bulbs were damaged. In Hidalgo County injurious infestations of grubs during the fall months occurred in cabbage seed beds, especially where these were planted following corn. During April heavy flights of bettles at Paris, Texas, caused some concern by severely defoliating young pecan trees. The principal species accompanying these reports of damage was *Phyllophaga bipartita* Horn. Two additional species, viz., *P. torta* Lec. and *submucida* Lec., were abundant locally and the feeding beetles caused noticeable damage, especially to Chinese Elm.

H. J. Reinhard.

Boll Weevil

Boll weevil infestation in certain bottom land fields was very low in 1937. The fall population did not increase much and only a comparatively few weevils entered hiberation.

Control: Under conditions of a medium infestation in Milam County calcium arsenate gave the best control, but was only slightly better than a 50 per cent mixture of calcium arsenate and hydrated lime.

J. C. Gaines.

Hibernation:

(In cooperation with the Bureau of Entomology and Plant Quarantine, U. S Division of Agriculture.)

Studies on the boll weevil in hibernation cages were continued as heretofore at College Station. Forty-five hundred field collected weevils were installed at weekly intervals from October 3 to November 7, 1936, in cages containing Spanish moss as shelter. All hibernation cages were situated under open field conditions, and each contained 500 weevils.

None of the weevils which resumed activity in the spring was removed from the cages until one week after the first young cotton plants began to appear in local fields. During the 1937 season this date occurred on April 16, as compared with March 30 in 1936.

Weather conditions during the winter 1936-37 were mild and considerably above normal; 27 degrees F. was the minimum, recorded in January 1937. Under these apparently favorable conditions, a total of 472 weevils or approximately 10.5 per cent of the 4500 individuals installed in cages survived the winter. This was a marked increase over the previous year, when temperatures during the winter dropped to 16 degrees F., and the survival recorded was only 1.6 per cent. Total weevil emergence from hibernation by months was as follows: April (16-30, incl.) 3.98 per cent; May 6.18 per cent; June (1-8, incl.) 0.33 per cent. The surviving weevils encountered hot dry weather from May to July, inclusive. During these months less than 5.5 inches of rain, distributed over nine days, were recorded at College Station. This extended period with subnormal rainfall accompanied by high temperatures proved very unfavorable for weevil multiplication, and no extensive damage was produced in local sections of the State.

H. J. Reinhard.

At Substation 19 at Winter Haven 1500 weevils were installed in the usual manner on November 7 and 16 in two cages containing corn and in one cage containing woods trash. Emergence was recorded from March 15 to May 13, when the last surviving weevil showed activity. A total of 9.73 per cent, the highest on record at Winter Haven, survived and emerged by months as follows: March 2.67, April 6.93, and May 0.13 per cent.

M. J. Janes.

The first work on boll weevil hibernation and survival in Northeast Texas was conducted at Substation 2, near Lindale in Smith County. A total of 1270 weevils was installed on October 3, 20, and November 3 in cages having crab grass as shelter. Surviving weevils were removed, beginning April 16. The percentage emergence in April, May, and June was respectively 0.39, 5.43, and 3.39 per cent, or a total of 9.21 per cent.

W. L. Owen, Jr.

Under the direction of the U. S. Bureau of Entomology and Plant Quarantine, 18,500 field collected weevils were installed in 37 hibarnation cages on October 15 and November 1. No attempt was made to collect weevils for the November 15 installation, as all cotton was killed by frost November 4. This caused active weevils to leave the fields.

Emergence was recorded from May 3 until June 19. The percentages of weevils emerging from the different types of shelter were as follows:

3.04 per cent from corn stalks in the open
8.62 per cent from Spanish moss in the open
8.30 per cent from Spanish moss in the woods
9.60 per cent from leaves in the woods

Total emergence in all cages was 6.24 per cent.

R. W. Moreland, Bureau of Entomology and Plant Quarantine.

Cotton Flea Hopper

Damage due to the presence of this insect, technically known as *Psallus seriatus*, was severe in the spring, particularly in the black lands of North and North-Central Texas. The infestation was slight in Central Texas, practically absent in the Lower Rio Grande Valley, and less than usual along the coastal prairie. It attracted more attention than usual in Northwest Texas, but because of favorable conditions for cotton in late summer and early fall, high yields were produced generally.

F. L. Thomas.

Migration or dispersal: More adult flea hoppers were taken on screen traps in 1937 than in 1936, but not as many as in 1933, 1934, and 1935. The largest numbers caught in 1937 on screens in cotton fields averaged nineteen during the week ending May 17, about the average date for the 1931-36 period. Within a month the population on cotton increased to a maximum of 73 per 100 buds, but quickly subsided. Very few flea hoppers were found on cotton in Central Texas after the middle of July and the occurrence of hot, dry weather.

J. C. Gaines.

Since it has been established that the flea hoppers drift with the wind, the direction of the wind currents during the spring migratory or dispersal period were determined in 1937 by releasing several thousand 9″ balloons. These releases were made from the sandy soil areas of seventeen counties in Central and South Texas, where the preferred weed host plants of the flea hopper are found and where the insects are known to overwinter in abundance. The prevailing direction of the wind during the period May 15 to June 12 was to the north and northeast. Many balloons from the sandy, croton infested areas were picked up in the black land area. It is in this black land area that flea hopper damage to cotton is more severe, and where the preferred weed hosts are less abundant. Flea hoppers undoubtedly drift into the black land areas and supplement infestations that develop locally from overwintering eggs.

J. C. Gaines, Texas Agricultural Experiment Station.
K. P. Ewing, Bureau of Entomology and Plant Quarantine.

Flea hopper abundance: The fall population of flea hoppers serves as a good index of the numbers of nymphs that will hatch the following spring. In the fall of 1936 there was a high average of 1450 adults per 100 sweeps on croton weeds near College Station. In the spring of 1937 the hatch was the largest since records were begun. However, the numbers found in weed fields during May and June were less than in 1934, 1935, or 1936. This was due to dry conditions unfavorable to growth of native vegetation and not suitable for development of the hoppers. In Northeast Texas the fall population in 1936 of 1904 adults per 100 sweeps was probably indicative of the conditions in that area which resulted in a large hatch and early damage to cotton in North Texas in 1937. The fall population of hoppers in the same area in 1937 was less than half that in 1936.

J. C. Gaines, and W. L. Owen, Jr.

Control: The following insecticides and combinations were used in a comparative test on flea hopper control: sulphur, sulphur-Paris green (93-7), and sulphur-calcium arsenate (90-10). Both the mixtures gave significantly better control than the sulphur alone, but the additional kill under conditions of a medium to light infestation did not warrant the extra expense of adding arsenicals.

J. C. Gaines.

Hibernation: Since the overwintering eggs are the only source of new flea hopper infestations at the beginning of each growing season, the progressive rate at which the young hoppers hatch and the effect of prevailing climatic conditions on their development become the most reliable index to prospective injury to the current crop. To secure such records during the season 1937, thirteen separate lots of 100 plants of the preferred host plant *Croton capitatus* were collected during November, 1936, in the following counties in South-Central Texas: Brazos, Burleson, Grimes, Madison, Milam, Robertson, Waller, and Washington. On February 8, 1937, each lot of croton weeds was placed in a separate cage.

The flea hopper eggs in the caged host plants began to hatch on February 18, as compared with March 6 during the previous season. There was only a slight increase recorded in the rate of hatching during the first half of March, but thereafter it was greatly accelerated by the more favorable weather conditions. Over one third or 34 per cent of the total emergence was completed during the latter half of March, and nearly 54 per cent from April 1 to 15, inclusive. The seasonal accumulative hatch totaled 88 per cent of the complete emergence by the middle of April. The total number of nymphs which emerged per 100 *C. capitatus* host plants is the largest since records were begun in 1926, and averaged 10,544, as compared with 6,031 in 1936; 6,020 in 1935; 7,481 in 1934; 5,234 in 1933; and 3,226 in 1932. Final hatching of nymphs from the overwintering eggs was noted on June 13. During the period 1926 to 1937, inclusive, an average of 6118 flea hopper nymphs were recorded per 100 *Croton capitatus* plants.

H. J. Reinhard.

The first hibernation work on cotton flea hoppers in Northeast Texas was conducted during 1936-37. Three hundred croton weeds collected in the fall of 1936 were installed February 25 in standard cages. First emergence occurred March 16. Of the total number recorded, 6 per cent hatched in March, 76 per cent in April, 10 per cent in May, and 8 per cent in June. The last flea hoppers to hatch were recorded June 17. An average of 10,781 flea hoppers hatched from 100 croton weeds, which helps to explain the severe early damage to cotton in North Texas.

The first adult hoppers were collected from weeds April 14, and by the second week in May 385 adults were collected from weeds in 100 sweeps. With the maturity of the spring host plants many of these insects migrated, while others transferred to favored hosts.

W. L. Owen, Jr.

Thrips

A severe thrips infestation became established on cotton and caused much concern during the dry weather until early in June, when rains put an end to the damage.

Dispersal and population studies showed that these insects, *Frankliniella tritici*, were in greater abundance than any time since 1934.

F. L. Thomas and J. C. Gaines.

Pink Bollworm

(In cooperation with the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture)

The investigations on the pink bollworm were conducted along the following lines: Breeding and colonization of introduced parasites, resistance of cotton varieties, control by cultural practices, insecticide control, factors influencing survival and field incidence.

Seasonal infestation records in widely distributed fields over the Presidio Valley showed that the pink bollworm infestation was higher in 1936 than in 1935. Since all of the fields were cleaned up in the fall of 1935, the increase was attributed to the unusually heavy worm population overwintering in the soil. The infestation records through August 31 indicated that the infestation in 1937 would be even higher than in 1936. Although the soil population was not abnormally high, there was a heavy carry-over above the ground since very few fields were cleaned up in the fall of 1936.

Parasite studies: In the studies on the establishment of introduced parasites, work was continued with *Chelonus blackburni* Cameron, *Exeristes roborator* Fab., *Microbracon kirkpatricki* Wilk., and the Hawaiian strain of *Microbracon mellitor* (Say). At Presidio all four of the species were recovered following initial colonization, and excepting *M. kirkpatricki* were found to survive the winter in hibernation cages, but their establishment is uncertain. Rearing of *E. roborator* for release which has been in progress since 1933 was discontinued after liberation this year of 5,500 adults in the Presidio Valley. Approximately 171,600 *C. blackburni* were released in the Presidio Valley. Since this parasite continued to emerge in hibernation cages after the pink bollworm had commenced breeding in the field it appears that this species has excellent chances of becoming established in Texas. Approximately 37,000 *M. kirkpatricki* were released at Presidio, Port Lavaca, and Weslaco. The releases at Port Lavaca and Weslaco were made in an effort to establish this parasite on the boll weevil. Five thousand *M. mellitor* (Hawaiian strain) were released in the Presidio Valley.

Varietal resistance: In tests conducted with various cotton varieties under conditions of heavy pink bollworm infestation, no resistance was shown by any of the varieties, all of them becoming 100 per cent infested. There did appear to be some indications that the grade was not lowered as much in the varieties with high lint percentage or high lint index as in the varieties with low lint percentage or low lint index. The results of spacing tests indicated that close spacing hastened maturity and tended to reduce the late seasonal pink bollworm damage.

Cultural control: Studies on the survival of larvae subjected to various cultural treatments showed that winter burial followed by a winter irrigation decreased the survival. Where no winter irrigations were applied, early winter burial gave a higher survival than late winter burial. The depth of burial was also an important factor on survival, the deeper the worms were buried the lower the survival. Moth emergence in the spring is influenced not only by the temperature but by the soil moisture, since delaying the application of a spring irrigation tended to delay the emergence. There was a much higher survival from the hibernation in 1937 than in 1936.

The construction of the large field cage covering approximately .80 of an acre was completed and a cultural test was conducted under it during 1936-37. The survival from the treatments in this test was contrary to the survival from similar treatments in the hibernation experiments. It was thought that there were factors other than the treatments that influenced the cage results, and further tests are planned in an effort to determine these factors.

Remedial measures: In cage toxicity tests with several insecticide dusts and sprays, barium fluosilicate dust again showed its superiority over the various insecticides tested.

A. J. Chapman, Bureau of Entomology
and Plant Quarantine.

Cotton Bollworm

(In cooperation with Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture)

Hibernation and spring emergence: The percentages of spring emergence of moths from pupae hibernating in the four types of soils used in the experiment were as follows: Cages installed on top of the ground, Lufkin Fine Sandy Loam 45 per cent; Norfolk Fine Sand 55 per cent; blackland soil 10 per cent; and Brazos River Bottom soil 20 per cent. In the cages installed below ground so that the soil inside was on a level with surrounding soil, Lufkin Fine Sandy Loam 20 per cent; Norfolk Fine Sand 30 per cent; blackland soil 10 per cent; and Brazos River Bottom soil 15 per cent. That is, 32.5 per cent of the pupae hibernating in the well-drained soils produced spring moths, while 18.8 per cent of the pupae hibernating in the poorer drained soils produced moths in the spring. The greatest mortality among pupae occurred early in the winter. Only worms which pupated between September 23 and October 10 produced moths the following spring.

Biological: In a study of the relation of succulence of the cotton plant to oviposition by *Heliothis obsoleta*, it was found there was a high correlation between the number of eggs laid and the per cent in the growing tip of the total moisture in the above ground part of the plant.

As in 1936, bollworm injury to cotton began about a week later than usual. This was possibly because corn was again later in maturing.

Natural control of eggs and first instar larvae: On 237 eggs tagged on cotton, less than 10 per cent reached the second instar. Eggs were washed from cotton plants by rain and destroyed by egg parasites and predacious insects. The first and second instar larvae were destroyed by predacious insects and spiders.

R. K. Fletcher.

Sulphur as an Insecticide

(In cooperation with Texas Gulf Sulphur Company and Freeport Sulphur Company)

Sulphur dust again gave better per cent control of flea hoppers than sulphur spray, but the difference did not affect the yields. This was probably due to the low infestation, which did not go above 32 hoppers per 100 terminal buds.

Experiments were begun to determine the relative merits of early dusting to control flea hoppers on land infested with cotton root rot. While the infestation was not sufficiently high to warrant control measures for more than two weeks, all dusted plants dying of root rot before August 5 showed an increase in yield over the untreated plants dying during the same weekly periods. The differences are small but consistent over the greater portion of the picking period.

S. E. Jones and F. L. Thomas.

For the first time experiments on flea hopper control were conducted in Northwest Texas at both Spur and Lubbock. The insect infestation was reduced in about the same proportion by sulphur alone and by a sulphur-calcium arsenate mixture, but yields were erratic. Dusting at seven-day intervals was apparently more effective than when applied at ten-day intervals. The maximum infestation at Spur was 82 and at Lubbock 139 flea hoppers per 100 plants.

F. L. Thomas and W. S. McGregor.

In experiments at Weslaco, sulphur proved to be better in the rotenone bearing dust mixtures than clay when used for control of cabbage worms.

S. W. Clark.

Pecan Insect Investigations

(In cooperation with the School of Agriculture, A. and M. College of Texas)

The absence of an infestation in 1936 again prevented progress in the pecan nut-case bearer investigations. Instead, attention was turned to control of the pecan leaf-case bearer, *Acrobasis hebescella,* in the vicinity of Navasota, where an orchard containing trees 30-50 feet in height was found to be infested by both the leaf case bearer and the obscure scale.

Oil emulsions prepared by three methods, cold stirred, using steam, and by adding aluminum napthenate were used along with lime-sulphur and an oil emulsion containing dinitro-o-cyclo-heryl-phenol. Applications were by means of a standard power spraying machine producing 350 pounds pressure.

The home-made emulsions were applied in sprays which contained 4 per cent and 8 per cent actual oil, and the dinitro emulsion at 2 per cent, 4 per cent, and 8 per cent strengths. The best control was obtained with emulsions made by using steam and the dinitro emulsion. Oil emulsion made with steam and containing 4 per cent actual oil effected a control of from 74 to 82 per cent. Those containing 8 per cent actual oil gave a control of 71 per cent to 95 per cent. The dinitro emulsion, which contained 2 per cent oil, gave a control of 81 per cent; that containing 4 per cent oil gave a control of 89 to 100 per cent; and the dinitro emulsion containing 8 per cent oil gave a control of 99 per cent.

There was no visible twig damage from 4 per cent oil, but when 8 per cent was used there was some damage and in two cases rather serious damage. There was no evidence of damage from the dinitro emulsion at 2 per cent, 4 per cent, or 8 per cent when applied before the buds began to burst, but evidently this material cannot be applied after the tree has commenced to bud, as some damage resulted to those trees which were sprayed on March 28.

S. W. Bilsing, School of Agriculture.

Devil's Shoestring, *Tephrosia virginiana* Linn as an Insecticide

(In cooperation with the School of Agriculture, A. and M. College of Texas, and Bureau of Plant Industry, U. S. Department of Agriculture)

Practically 70 per cent of the plants of this species found on one acre of the Sandflat district in Smith County were found to be decidedly toxic. It seems reasonably certain that throughout this district cultivation of the plant will yield a root crop of good quality. No other district of similar size with roots of equal quality has been found in such proportion.

Toxic substances located mostly in the roots appear to be uniformly toxic without regard to size of the roots.

Studies have been continued on the variation of the rotenone conten in individual plants from year to year and from season to season. Some variation occurs in individuals from one year to the next, but on a average the rotenone content was found to be the same. Marked seasonal variation has been found to exist. Samples of roots dug durin the growing season may contain 100 per cent more rotenone than corresponding samples from the same individuals dug in December. Th total carbon tetrachloride extractives are also higher but not as high i proportion as the rotenone content. Not only is there seasonal variatio and variation from one year to the next, but there is variation in th rotenone content of plants growing side by side and grown from crow divisions of the same parent plant.

Pollination studies have shown that pods have been set and seeds produced from flowers enclosed in cheesecloth bags and from plants in screen-wire cages where tripping the flowers or shaking the plants has been practiced. Isolated plants have been observed to set fair crops of seeds. A collection of insect visitors of the flowers and pests has been made. Planting the current year's seeds in the shade, directly after harvesting, wa continued with fair success.

V. A. Little, School of Agriculture, and
G. A. Russell, Bureau of Plant Industry.

A *Tephrosia*-sulphur dust was as effective as Cube'-sulphur in controllin cabbage worms when the mixture contained the same quantity of rotenone and was more effective than calcium arsenate.

F. L. Thomas, et al.

Southwestern Corn Borer

The insect, *Diatraea grandiosella,* which has been reported throughou the Panhandle of Texas, was found in 1937 to have extended its range eas into Wilbarger County and south to Taylor County in West Central Texas In an incompleted survey the Southwestern corn borer was found i thirteen new counties. It is rapidly becoming a major pest and alread threatens corn production in a number of counties.

F. L. Thomas and W. S. McGregor.

Truck Crop Insect Investigations

The Hawaiian beet webworm, *Hymenia fascialis,* completely destroye fall beets in the vicinity of Galveston and Harris counties, where n control was attempted. Pyrethrum-sulphur mixtures containing .1 pe cent pyrethrins and applied at the rate of 25 pounds per acre at weekl intervals, beginning when the plants were about two inches high, gav excellent control.

Tomato fruitworm, *Heliothis obsoleta,* was controlled better with 25-75 calcium arsenate-sulphur mixture than with a pyrethrum-sulphu mixture containing .1 per cent pyrethrins or with a pyrethrum-rotenone-sulphur combination.

The turnip aphis, *Rhopalosiphum pseudobrassicae*, was satisfactorily controlled within twelve hours by pyrethrum-sulphur mixtures containing .1 per cent pyrethrins.

J. N. Roney.

Early in January 1937 the Red Spider, *Tetranychus telarius*, appeared on strawberry plantings of 1935. One application of a conditioned sulphur of 325-mesh was applied at the rate of 25 pounds per acre with excellent results. These spiders attacked only plants that had been set out at least sixteen months, while plantings of November, 1936, have not been attacked; therefore, no control measure was applied.

During the bearing of fruit in March, April, May, and June we found much fruit injured by mole crickets and pill bugs, *Gryllotalpa hexadactyla* and *Scapteriscus acletus*. A poison bait of the following gave good results for controlling these pests: 12½ pounds of cotton seed meal, ½ pound white arsenic or Paris green, 1 quart of any good syrup (no corn syrup), and 1½ gallons of water.

J. N. Roney.

Apiary Inspection, 1936-1937

Less than one per cent of the colonies inspected since 1933 were found infected with American foulbrood disease. During the past season 0.74 per cent were found infected and destroyed. This is the lowest percentage on record for a full year's work.

The inspectors visited 43,780 colonies in seventy-five counties for 639 beekeepers.

Queenbreeders' certificates were granted to forty-six beekeepers who desired to ship package bees and queens.

Two full time and four part time inspectors traveled a total of 19,885 miles in the inspection work.

C. E. Heard and C. J. Burgin.

AGRONOMY

Oat Investigation and Improvement

Since the work of this project is conducted at Substation No. 6, Denton, the results are presented in the report of that station.

Fertilizers for Field Crops

The object of the work with fertilizers is to determine the fertilizer needs of the principal crops on the more important soils in the state and from this to formulate suitable fertilizer recommendations for these crops.

In 1937 the work was conducted at the Main Station, College Station; at Substation No. 2, Tyler; and at Substation No. 3, Angleton. Only a brief summary of the results is given here for the reason that a more detailed account of the results will be given in the reports of the stations concerned.

Cotton is included in the experiment at all three points.

On the sandy soils at Substation No. 2, Tyler, the use of a 4-6-4 fertilizer continues to be more profitable for cotton than fertilizers containing a wider ratio of nitrogen and phosphoric acid. The 4-6-4 fertilizer applied at the rate of 400 pounds per acre before planting or at planting time, or a fertilizer with the same amount and proportion of plant food is recommended for cotton on the Kirvin soils and associated soils of the region.

The yields obtained in 1937 in the fertilizer work with cotton at College Station on Lufkin fine sandy loam soil were slightly larger than the average yields for the eleven years 1927-37. The treatment of 800 pounds per acre of a 4-12-4 fertilizer made the largest yield, 369 pounds of lint per acre, which is 160 pounds, or 76 per cent more than the yield of the untreated soil. During the eleven years 1927-37 the treatment of twelve tons of manure and 400 pounds of superphosphate produced the highest yield, 364 pounds of lint per acre. On the average manure used at the rate of eight tons and twelve tons per acre has been worth about $1 per ton. The results of the work during the eleven years indicate that the use of about 400 pounds per acre of a 4-12-4 fertilizer is good farm practice for cotton on Lufkin soils.

The results of the fertilizer work on cotton at Substation No. 3, Angleton, on Lake Charles clay soil indicate that this soil is more deficient in nitrogen and phosphoric acid than in potash. The season of 1937 was favorable for cotton production and the yields in this test averaged slightly more than a bale per acre. The treatment of 800 pounds per acre of an 8-12-8 fertilizer made the largest yield, 804 pounds of lint per acre, which was 359 pounds, or 80 per cent more, than the yield of the soil which received no fertilizer. This treatment also made the largest yield (521 pounds of lint per acre) and the second largest profit ($5.52 per acre) during the six years 1930-37. The use of small amounts of fertilizer, such as 400 pounds per acre of 4-6-4 or 4-8-4 fertilizer, however, seems to be more practical in general farm practice. These treatments have returned on the average about $1.90 for each dollar spent for fertilizer as compared with $1.25 to $1.40 for the heavy applications.

Corn is included in the fertilizer experiment at College Station, Tyler, and Angleton.

The results obtained with corn at College Station in 1937 are in general agreement with the average results during the eleven years of the experiment; that is, fertilizers have made some increases in yield, but in general have not been profitable. Although fertilizers have increased the yield of corn, there does not seem to be any consistent relation between yield and amounts of nitrogen, phosphoric acid, and potash or the rates of application of a 4-12-4 fertilizer.

On the sandy lands at Substation No. 2, Tyler, the application of 100 pounds of sulphate of ammonia to corn where the corn follows a well-fertilized crop, as cotton or potatoes, has been the most profitable commercial fertilizer.

At Angleton in 1937, the yield of corn increased from 38.3 to 45.4 bushels, as the percentage of nitrogen was increased from nothing up to 8 per cent in combination with superphosphate and potash. The yields also increased in general as the rate of phosphoric acid was increased. These results indicate that 200 to 400 pounds of a 4-8-0 or a 4-10-0 fertilizer should be satisfactory for corn on the Lake Charles soils.

Oats are included in the work at College Station only. In 1937 the soil treated with 800 pounds of a 4-12-4 fertilizer per acre made the largest yield of grain, 31.2 bushels per acre, or nearly three times as much as the untreated soil. The application of 600 pounds made the second largest yield of grain (29.3 bushels per acre) and the highest yield of straw, 3448 pounds. Considering both straw and grain, this treatment produced considerably more dry matter per acre in 1937 than any of the other seventeen treatments in the experiment. During the 10 years of the experiment, however, the 800 pounds of the 4-12-4 fertilizer has made the highest average yield of both grain and straw per acre. None of the fertilizers used have returned a profit, although the application of 200 pounds per acre of a 4-12-4 fertilizer has about paid for itself. These results with oats on Lufkin fine sandy soil indicate that oats do not respond readily to applications of fertilizers and that oats probably will be more profitable if they follow a well fertilized crop, such as cotton or corn.

E. B. Reynolds.

Rotation, Fertilizer, and Soil Improvement Investigations

In the various cropping systems used at Temple, cotton was grown continuously ⅔, ½, ⅓, and ¼ of the time. During the years cotton was not grown, crops immune to cotton root rot were grown, except in two instances. In one case, guar, a root rot resistant legume, was grown, and in the other case the land was clean fallowed.

The yield of rotated cotton, during the period 1931 to 1936 inclusive, was higher than the yield of non-rotated cotton, regardless of the rotation used or the severity of root rot. Cotton yields were progressively higher the less frequently cotton was grown. Cotton yielded 237, 258, 272, 300, and 321 pounds of lint per acre, respectively, for the cropping systems in which cotton was grown continuously, ⅔, ½, ⅓, and ¼ of the time. Also the control of root rot secured was greater the less frequently cotton was grown. The average percentages of cotton stands lost by root rot during the period 1931 to 1936 inclusive were 67, 69, 63, 46, and 25, respectively, for the areas planted to cotton continuously, ⅔, ½, ⅓, and ¼ of the time.

The highest cotton yields were secured in the rotations using cotton only ⅓ and ¼ of the time and in which the greatest control of cotton root rot was secured. Small increases in cotton yield were also secured on the rotations in which cotton was grown as frequently as ⅔ and ½ of the time and in which root rot was not controlled. In these rotations the crop immediately preceding cotton influenced the yield of cotton. Cotton yields were highest when preceded by corn, guar, and oats. The effect of these crops, apparently, was associated with the quantity of plant residue plowed under and the earliness of soil preparation for the cotton crop. The yield of cotton following sorghum was very similar to the yield of continuous cotton.

The yields of the non-susceptible crops grown were affected in varying degrees by the rotations used. Rotation with other crops increased the yield of corn and sorghum compared to the continuous growing of these crops, while non-rotated oats yielded just as high as did rotated oats. The frequency with which corn and sorghum were grown in the rotation had very little effect on their yield. Although the yield of oats was not affected by rotations, the crop preceding oats materially affected the oat yield. The highest oat yields were obtained when the preceding crop provided a clean, firm seed bed for planting oats. The yield of oats was highest when preceded by cotton and lowest when preceded by sorghum.

H. E. Rea.

Comparison of Nitrogenous Fertilizers

The object of this test is to determine the relative merits of different nitrogenous materials used as fertilizers for cotton. In the past, several materials have been used, but in 1937 only nitrate of soda and sulphate of ammonia were included in the experiment. These were used to supply the nitrogen in a 4-8-4 fertilizer applied at the rate of 400 pounds per acre.

In 1937 the work was conducted only at the Main Station, College Station. There was practically no difference in the yield from plats receiving nitrate of soda and those receiving sulphate of ammonia, the former producing 311 pounds of lint per acre, and the latter 316 pounds. During the last six years, however, nitrate of soda has produced an average yield of 294 pounds of lint per acre and sulphate of ammonia, 279 pounds. This small difference is not significant. These results indicate that these two sources of nitrogen have about the same value as fertilizers for cotton on the Lufkin soils, which are the principal soils of the region.

E. B. Reynolds.

Polyhalite as a Source of Potash for Fertilizer

The main purpose of this work is to ascertain if polyhalite is a good source of potash for commercial fertilizers. Polyhalite, which is a mineral containing potash, is found extensively in the potash beds in western Texas. It is important to know the availability of the potash in polyhalite, as a basis for developing the commercial utilization of the material in the fertilizer industry. This study is conducted only at the Main Station, College Station.

Red polyhalite and white polyhalite were compared with muriate of potash in a fertilizer experiment with cotton. These materials were used in such amounts as to supply the same quantity of water-soluble potash in 400 pounds of a 4-8-4 fertilizer. In 1937 fairly good yields of cotton were obtained. Plats that received muriate of potash produced 316 pounds of lint per acre; those receiving white polyhalite, 315 pounds; and those receiving red polyhalite, 314 pounds. These yields are practically identical. As an average for the three years 1933, 1935, and 1937, white polyhalite produced an average yield of 335 pounds of lint per acre; red polyhalite, 306 pounds; and muriate of potash, 317 pounds. These results indicate that the potash in polyhalite is as readily available to the cotton plant as the potash in muriate of potash.

E. B. Reynolds.

Hairy Vetch for Soil Improvement

In this study hairy vetch is seeded in the early fall and plowed under in early spring as a green-manure crop for cotton at College Station. Some of the plats of vetch receive 300 pounds of a 4-8-0 fertilizer when the vetch is seeded, while the other plats receive nothing. All of the vetch is inoculated with the proper legume bacteria. When the vetch is plowed under in the spring, part of the plats which received the 4-8-0 in the fall receive 200 pounds of 4-8-0 and 16 pounds of nitrogen in sulphate of ammonia, while the other plats receiving 300 pounds of 4-8-0 in the fall are treated with 200 pounds of 4-8-0. These treatments are compared with vetch alone, with 500 pounds of 4-8-4, and with untreated plats.

In 1937 only moderate yields were obtained on account of the severe drought in July and August. The plats that received 4-8-4 fertilizer made a yield of only 278 pounds of lint per acre; those plats receiving vetch and 4-8-4, 261 pounds; vetch and 0-8-4, 267; vetch alone, 233; and the untreated soil, 186 pounds. The vetch plats that received only 0-8-4 (phosphoric acid and potash) made as large yields of cotton as the vetch plats which received the complete fertilizer. This indicates that if vetch receives enough phosphoric acid, it will fix enough nitrogen from the air for the cotton crop. The vetch plus 0-8-4 increased the yield of cotton about 44 per cent over the yield of the untreated soil. During the three years 1935-7 vetch plus 0-8-4 increased the yield of cotton 45 per cent and the 4-8-4 fertilizer 58 per cent as compared with the yield of the unfertilized soil.

The amount of nitrates in the soil on the several plats was determined at approximately two-week intervals from May until September, 1937. On the average, the soil on the plats on which vetch was plowed under contained about twice as much nitrate nitrogen as the plats which received the 4-8-4 fertilizer only or the untreated plats. Evidently the vetch provided more nitrogen than the cotton plants could use to advantage, for there was no significant difference in the yield of cotton on the vetch plats with 0-8-4 and the vetch plats with 4-8-4.

E. B. Reynolds.

Plant Introduction

As opportunity permits, plants that appear to have some promise of success are introduced and tested. No outstanding results, however, were obtained in 1937.

E. B. Reynolds.

Inheritance in Cotton

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

The object of this project is to study the inheritance and linkage relations of various characters of cotton, especially the major economic ones, as a basis for further improvement of the crop. The results of this study will be used in the breeding work to improve the present varieties through hybridization, back-crossing, and selection.

During the year a large number of new intervarietal and interspecies crosses were made to determine the inheritance and linkage of several characters in various combinations in new synthetic lines, the interrelationships of which have not previously been studied. This work includes studies on plant type, leaf shape and color, petal color, petal spot size and color, anther and pollen color, boll size, boll surface and suture, seed shape and covering, lint color and the abundance, length, and fineness of the lint in relation to its spinning value.

Work on the cooperative project, begun in 1936 with the Bureau of Plant Industry to study the inheritance of fiber fineness, was continued during the year. The fineness of fiber appears to have a close relationship to the spinning properties of cotton. Consequently this project has important economic possibilities and offers opportunity for increasing the value of the cotton crop through the development and general use of higher yielding varieties possessing the desired fineness of fiber. Crosses have been made between fine-fibered types and productive strains with medium to coarse fibers, using Hopi as the principal fine-fibered parent in the crosses. In this work a system of parallel backcrossing to both parental lines, known as convergent improvement, is being employed with the view of isolating fine-fibered strains with high yield and other desirable qualities. During 1937 the F_1 generations of Hopi X Kekchi, Acala 7-4, Acala Q 6, Lone Star P4-1, and Delfos, respectively, were grown, and in addition, the F_1 of crosses of Lone Star X Meade, Rowden X Meade, Lone Star X P 11, Half and Half X P11, and Half and Half X Sea Island.

First backcross generations of Hopi X Acala F_1 to Acala and to Hopi show considerable differences in the general appearance of these two lines. The number of Acala-like plants with apparently fine fibers recorded from the backcross to Acala is gratifying. In this work it is important that more accurate and rapid methods of determining the fineness of fibers be developed in order to permit a more reliable classification of the segregating material, and work to improve the technique of determining fiber fineness is now under way. Present indications are that fiber fineness may be controlled by not more than three or four genes, and therefore may not be a strictly quantitative character in the sense that the character involves many genes as was once thought.

Studies on the inheritance of the hairy condition of the plant in which several factors appear to be concerned were continued and several new crosses were made, including five additional high-yielding varieties, with the view of introducing the hairy condition into the more productive and widely adapted varieties. Hairiness is of considerable importance from the standpoint of insect control, since it has been found that plants with a high degree of hairiness retain a larger amount of the poison dusted on the plants for insect control.

The third backcross generation was grown during the year in the study of the effect of leaf color and shape on yield. In this work repeated selective backcrosses and genotypic tests of progenies are made with the view of isolating lines that differ only by a single gene in the various gradations of leaf color and shape, involving red, green, bronze, and virescent yellow leaf color, and normal and okra leaf shape. After the various types have been fixed, a field yield study of the Latin square type will be made to determine what effect the shape and color of leaf have on yield. This study has an important relation to the work of breeding types of cotton for mechanical harvesting, in which an attempt is being made to develop higher yielding varieties with smaller leaf area, more determinate fruiting habit, and more compact plant type, than found in ordinary varieties.

Studies on hybrid vigor and on the practical utilization of hybrid vigor in developing high yielding strains of cotton were continued.

In the study of the inheritance of length and percentage of lint, involving Half and Half X Lone Star, some highly productive strains have been developed. These strains are being repeatedly inbred and selected, and several in the F_6 equaled or exceeded the yield of the high yielding Half and Half parent and combined the good boll and lint qualities of Lone Star.

The results obtained in 1936 from crosses of naked seed-lintless by covered seed-lint bearing in which the lint index on each F_2 segregate was determined, have shown that the naked-lint bearing class was intermediate but in the direction of the covered seed-lint bearing class. New crosses were made this year to study this relationship further and to determine the possibility of obtaining lines with naked seeds that bear lint equal in abundance to that of our more productive strains. Combination crosses involving covered seed, semi-fuzzy seed, fuzzy tipped, and naked seed have been made for a more detailed study of seed fuzz patterns and other characteristics of seed fuzz.

Independent inheritance was observed in crosses between brown and green lint and since each character was incompletely dominant to white lint, the phenotypic classes conformed to the normal dihybrid genotypic ratio, which had not heretofore been demonstrated. Furthermore, investigation of the relationship between color in the lint and color in the seed fuzz produced evidence to show that the genes for brown lint and green lint have an effect on the seed fuzz. In addition to these genes, a recessive gene for green seed fuzz has been found which apparently has no effect on the color of the lint. Classification of the lint colors from the various individuals in the F_2 of the brown lint by green lint cross was checked by colorimetric and spectrophotometric analyses. Selfed seed will be used from plants growing in the greenhouse during the winter to grow an F_3 of the segregates from the brown lint by green lint cross in 1938 for verification of the F_2 classification. These studies have an important economic bearing on cotton production in that they afford an opportunity to study lint and seed fuzz separately. A paper on this subject was presented at the annual meeting of the Association of Southern Agricultural Workers in February, 1938.

Studies were completed in 1937 on the inheritance of boll apical furrow in which two classes of furrow were observed. Slight variability in boll type was noted, which influenced to some extent the expression of this character. Boll apical furrow is a partial dominant to the absence of apical furrow. Dihybrid F_2 ratios were observed in crosses between deep apical furrow and no apical furrow. Monohybrid ratios were indicated in crosses between intermediate apical furrow and no apical furrow, and between deep apical furrow and intermediate apical furrow. Satisfactory backcross ratios were obtained between the different classes of furrow and no furrow. The results obtained in this study would indicate that the deep apical furrow is due to the action of two dominant gene pairs, the intermediate apical furrow to one pair of these dominant genes, and no apical furrow to the absence of both pairs of dominant genes.

The genetic data on other characters being studied are still in the process of summarization, and therefore, the final results are not available at this time.

The Division of Rural Home Research and the Division of Agronomy are cooperationg in a study of the inheritance of the physical properties of the cotton fiber, involving crosses between Half and Half with short coarse lint and Lightning Express with long fine lint. This material is now in the process of physical analysis.

D. T. Killough, T. R. Richmond (Bu. Pl. Ind.), R. E. Harper.

Cotton Variety Tests

Tests with varieties of cotton were conducted at the Main Station and at the substations during the year. In addition to these regular tests, cooperative variety tests were conducted at the Federal stations at Greenville and Big Spring, and on the Chance plantation on the alluvial soils along the Brazos River near College Station, in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture, and in Nueces and Young counties in cooperation with the Extension Service.

In general, medium staple, early maturing types of cotton developed in Texas, including strains of the Triumph type, such as Mebane, New Boykin, Ferguson 406, Watson, Cliett, Harper, Qualla, and Kasch, have a relatively wide range of adaptation in the state, and continue to give better results at most of the stations than varieties from other states. Lone Star, Lankart, and Rowden, and their related strains are well suited to the central and eastern parts of the state. The Acala strains continue to rank among the more profitable varieties in the tests conducted in the southern, central, and northern portions of the Blackland belt. Several strains developed by the Texas Station, including Startex 619, Mebane 140 and 141, Sunshine 74-2 and 83-3, and Mebane 804-50, have made a good showing in the tests at several points in the state.

In the cooperative regional variety tests conducted on alluvial soil on the Chance plantation, the longer staple varieties, Rogers Acala, D & P L 11, and Missdel 4, produced high yields and were the more profitable varieties.

In the Gulf Coast Prairie the longer staple varieties, D & P L 11, Stoneville 2B and 4A, and the larger boll strains of Delfos, have given good results. Strains of D & P L have also been outstanding in the tests in the central and western parts of the state, and in areas where cotton is grown under irrigation.

During the year mimeographed Progress Reports 472 and 487 on variety tests of cotton were published. Progress Report 472 furnishes information on the yield, length, and percentage of lint; size of boll; and monetary value per acre of lint and seed of all varieties, including those of commercial importance tested at the Main Station and the fifteen substations during the period 1923-37. In this report the varieties at each station are listed according to their monetary value per acre based on average prices of lint and seed for the five-year period, 1933-37, and for the year 1937. Progress Report 487 gives the results of the regional cotton variety test conducted on the Chance plantation. These reports should be helpful in selecting suitable varieties of cotton for the various sections of the state, and of special interest to communities desiring to produce a better quality of cotton on the basis of one variety to the community.

D. T. Killough.

Time and Method of Intertillage

Work under this project is being conducted at Substation No. 12, Chillicothe, and the results will be given in the report of that station.

E. B. Reynolds.

Time and Method of Seed-Bed Preparation

This work is being done at Substation No. 8, Lubbock, to determine the best time and method of preparing the land for cotton and grain sorghum. The results of these studies will appear in the report of Substation No. 8.

E. B. Reynolds.

Cotton Improvement

The purpose of this work is to develop higher-yielding varieties of good quality staple for given regions of the state. Straight selection and hybridization, followed by backcrossing and inbreeding, are being employed in the cotton improvement work.

Several outstanding strains of Mebane have been developed at several stations in recent years, including Mebane 804-50 at Beeville, Mebane 804-36 at Angleton, and Mebane 140 and 141 at Chillicothe. These strains have not only been among the higher yielding and more profitable varieties at the stations where they were developed but have shown a rather wide range of adaptation over the state. At the Denton station two selections of Sunshine, 74-2 and 83-3, have been outstanding in the tests there, producing a good quality of one inch staple. Startex 619, a selection from Lone Star, continues to be one of the highest yielding varieties in the test at College Station since its introduction in 1931. At Lubbock, some promising strains are being developed through hybridization and backcrossing. The most desirable of these which are now comparatively uniform in type are being grown in randomized field yield tests with the better adapted commercial varieties.

The inbreeding work with strains of Mebane 804, in which open-pollinated mass field selection, open-pollinated individual plant selection, and individual inbred plant selection methods of breeding are compared, was continued at the Angleton station in 1937. Inbreeding has resulted in greater uniformity of the more important characters being studied, as well as in marked increase in production in some of the inbred strains.

In the breeding work at Nacogdoches hybridization followed by backcrossing and inbreeding has been used since 1933 for the purpose of combining the good staple and boll qualities of Lone Star with the high yield, high percentage of lint, and earliness of Half and Half with the view of developing a better variety of cotton for the region. The seventh generation of the crosses between these two varieties was grown in 1937. Several of these strains are now quite uniform and have shown definite superiority over the parents in certain characteristics in comparative yield trials for the past three years. These are being increased as rapidly as seed will permit.

Seed of the improved strains developed by the Experiment Station are being distributed to farmers through county agents and vocational teachers in different parts of the state in order to give them a wider and more comprehensive test. The proved superior strains are also put into channels of commercial production through state certified seed growers and others.

D. T. Killough.

Rate and Distribution of Seed and Time of Thinning Cotton

This project was conducted at College Station in 1937 to determine the best spacing of cotton at three levels of fertility. The cotton plants were spaced 12, 18, and 24 inches apart in 3-foot rows on unfertilized soil and on soil that received 400 pounds and 800 pounds of a 4-8-4 fertilizer per acre. Considering spacing only, the 12-inch spacing yielded 266 pounds of lint per acre; the 18-inch spacing, 263 pounds; and the 24-inch spacing 250 pounds. Thus, the yield decreased as the spacing was increased, although the small differences in yield are not significant.

Considering now the different levels of fertility, we find that the untreated soil produced 218 pounds of lint per acre; the soil treated with 400 pounds of fertilizer, 268 pounds of lint; and the soil that received 800 pounds of fertilizer, 293 pounds of lint. The soil that received fertilizer produced significantly larger yields than the untreated soil.

During the two years 1936-37 the 12-inch spacing made the highest average yield at each of the three levels of fertility.

E. B. Reynolds, G. T. McNess.

The Study and Improvement of the Peanut

The experimental work carried under this project, which includes breeding and selection and tests with varieties and fertilizers, is conducted at the Main Station Agronomy Farm. The results of the work are discussed in the report of the Main Station Agronomy Farm.

G. T. McNess.

Rice Improvement and Methods of Production

The work carried under this project is conducted at Substation No. 4, Beaumont, and the results obtained in 1937 are given in the report of that substation.

E. B. Reynolds, R. H. Wyche, H. M. Beachell.

Wheat Breeding

Most of the work on this project is conducted at Substation No. 6, Denton, and results are given in the report of that station.

Run-off Water Losses in Relation to Crop Production

Since this project is conducted at Substation No. 7, Spur, the results are stated in the report of that station.

R. E. Dickson, B. C. Langley, C. E. Fisher.

Inheritance and Improvement in Corn

The new yellow-seeded varieties of corn developed by the Texas Station, Yellow Surcropper, Golden June, Yellow Tuxpan, and Golden Thomas, have continued to be very popular with growers and the demand for seed has again far exceeded the supply. There has been additional improvement in the carotene content of all of these varieties so that they are now more attractive in appearance and possess a higher vitamin potency than when first distributed. One additional new variety, Texas Golden Prolific, has been added to the list and seed will be distributed for the first time in 1938. This variety was produced by converting Hastings' Prolific from a white- to a yellow-seeded type. It is very similar to Hastings' in all of its characteristics and should be well adapted to the region in East Texas where the prolific types have always been extensively grown.

The most interesting development in the sweet corn breeding during the past season has been the outstanding performance of a first generation hybrid of Mosshart Sugar X Purdue 39. The former is a new variety of sweet corn developed from Mosshart Yellow Dent, and the latter is one of the best inbred strains of Golden Bantam sweet corn in the country. The first generation hybrid combines some of the earliness and fine quality of Golden Bantam with the ear-worm-resistance of Mosshart, and is the most attractive and highest quality sweet corn that we have included in our tests. Further tests to determine its commercial possibilities are being made.

P. C. Mangelsdorf.

Pasture Improvement and Management for East Texas

The pasture work carried under this project is largely of a practical nature and is conducted at Tyler, Lufkin, and Beaumont. The results are discussed in the reports of these stations.

E. B. Reynolds.

The Genetic and Cytological Relationships of Zea, Tripsacum and Euchlaena

(In cooperation with School of Arts and Sciences, A. & M. College)

Recent developments in this project have led to the conclusion that teosinte, the closest relative of corn, is not, as many botanists have supposed, the prototype of corn but is the result of a natural hybrid between corn and Tripsacum, a species of wild grass which grows from Central America to Massachusetts. Teosinte differs from corn primarily by four chromatin segments which have, apparently been received from Tripsacum.

These new discoveries re-open the entire question of the origin of corn. It now seems very likely that corn originated in South America, either in Peru or Bolivia, and that it was growing there as a wild plant when the Indians, who came originally from Asia by way of Alaska finally discovered it. This wild corn was probably quite similar to the pod corn known today which bears its seeds completely enclosed in the glumes. Evidence is accumulating to show that the hybridization of corn and Tripsacum, which occurred in Central America after corn had been carried there by the Indians, gave rise, not only to the new genus Euchlaena, commonly known as teosinte, but also to the development of some new types of corn previously not in existence. Among these new types are the pointed-seeded pop corns and the long slender flint and flour corns. The modern dent varieties of today evidently had their origin from the hybridization of the southern gourd-seed types which came into North America through Florida and which are typical Peruvian corn, and the long slender flint corn which was originally developed in the Southwest and later spread to the northern part of the United States. This means that practically all of the North American varieties grown today have some Tripsacum "blood" in their germplasm, a circumstance which may well have a bearing on the corn improvement program.

The data on this subject as well as all the literature bearing on the question are being summarized for publication.

P. C. Mangelsdorf and R. G. Reeves.

Mechanical Harvesting of Cotton

The project is conducted jointly by the Division of Agricultural Engineering and the Division of Agronomy. The agronomic phases of the work reported here consist chiefly of studies to determine the adaptability of varieties to mechanical harvesting and to develop a variety or varieties better adapted to mechanical harvesting than the commonly grown varieties.

Twenty varieties and strains of cotton were included in the harvesting tests at College Station and Lubbock in 1937, and the effect of different plant and boll characteristics on the harvesting qualities of the different varieties was studied. Varieties with restricted vegetative growth, having relatively large storm-proof bolls, borne in semi-cluster but singly on long, thin peduncles, were harvested more efficiently by the machine and with less trash than varieties that did not possess these characteristics.

The breeding work to develop types of cotton better suited to mechanical harvesting than the commonly grown varieties was continued at College Station and Lubbock in 1937. In this work straight selection as well as hybridization is being employed. The Ducona variety has one of the most desirable plant types from the standpoint of mechanical harvesting of all varieties that have been tested. Continued inbreeding and selection have resulted in the isolation of several uniform strains which are more productive and have a higher percentage of lint and larger and more storm-proof bolls than the original type of Ducona. In order further to improve these strains crosses were made with other varieties having certain desired characters which the Ducona strains lack. These hybrid lines are being backcrossed and inbred to obtain high yielding strains uniform in type. One of the most promising of these hybrid strains is a cross between Ducona and Lone Star. The F_2 and backcross generations of this cross were grown in 1937 and a number of selections made for increasing and further testing in progeny rows in 1938. In the breeding work special attention is being given to the development of types with a more determinate fruiting habit, with smaller leaves, and with the bolls in semi-cluster and each boll borne separately on a long, thin peduncle than in pairs on fused peduncles. Types having these characteristics may be harvested more efficiently by the stripper with appreciably less trash to lower the grade of the cotton than is the case with the original cluster type of Ducona with fused bolls borne on short, thick peduncles. The okra leaf Acala crosses continue to be promising and satisfactory harvesting tests were made on some of the strains being grown in increase plats during 1937.

One of the present objectives in the breeding work is to develop types with fruiting branches intermediate in length between the short- and normal-branch types. While the short fruiting branch is conducive to the efficient operation of the harvester, this characteristic appears to be associated with abortive shedding of the young squares. Types with intermediate length fruiting branches show practically no tendency to abort the squares, the bolls are not fused, and are easily removed from the plant by the harvester. The intermediate length fruiting branch character of Ducona is being introduced into several high-yielding varieties with normal length fruiting branch by means of repeated backcrossing and progeny testing to insure the retention of this character.

In the work at Lubbock strains are being developed that mature early enough to escape damage by frost, thereby reducing the amount of bollie cotton. The more promising of these include strains of Kubela, cut leaf Acala, Mebane 140, and hybrid strains of Westex X Lightning Express, Clark X Acala, Half and Half X Ducona, and Ducona X Lone Star. Some of these strains which were grown in the larger increase plats gave very satisfactory results in harvesting tests with the Texas Station harvester in 1937.

The results of other phases of the project, including the efficiency of cotton harvesting machinery, the development of cleaning machinery, and the cleaning and ginning of mechanically harvested cotton, are given in the report of the Division of Agricultural Engineering.

D. T. Killough, H. P. Smith, D. L. Jones.

Variety Test of Legumes

In 1937 this work included only tests with soybeans at the Main Station, College Station; Substation No. 2, Tyler; Substation No. 3, Angleton; and Substation No. 6, Denton.

Of the fourteen varieties of soybeans in the test at College Station, only Manchu produced seed in the early and medium dates of planting, making 4.2 bushels per acre at the early planting (April 15) and 2.0 bushels at the medium planting. The other varieties made practical failures in seed production this year and also in 1936.

E. B. Reynolds, G. T. McNess.

At Substation No. 2, Tyler, the experiments with soybeans in 1937 included a test of 16 varieties planted at three different dates, April 2, May 4, and June 8, and a rate of seeding test using 20, 30, 40, and 60 pounds of seed per acre. In general the yields of hay were low at the three dates of planting, although the yields had a tendency to increase as the date of planting was delayed. The yield of seed of all varieties was low this season as usual. In the rate of seeding test, no significant differences in yield of hay were obtained from the Laredo, a small-seeded variety, at the different rates of seeding. With the Mamloxi variety, which has medium size seeds, the largest yield was obtained from the 40-pound rate.

E. B. Reynolds, P. R. Johnson.

At the Angleton Station the test was larger and more comprehensive, consisting of a variety test of eighteen standard varieties, fifty-six introductions, and a rate of seeding and inoculation tests. In the test of standard varieties, Virginia, Manchu, and Laredo made the largest yields of seed, which, however, were only 2.6, 2.4, and 2.0 bushels per acre, respectively. In the tests with fifty-six newly introduced varieties of soybeans F. P. I. Nos. 84739 and 85348 made the highest yield of seed, 19.0 and 17.8 bushels of seed per acre, respectively. During the two years 1936 and 1937, however, F. P. I. No. 85356 produced the highest average yield, 10.8 bushels per acre. Inoculation had no appreciable effect on the yield of seed or forage in 1936 or 1937. In the test with rates of seeding, using 20, 30, 40, and 50 pounds of seed per acre in cultivated rows, the 50-pound rate produced the highest yield of cured hay, 1.07 tons per acre, for the two years.

E. B. Reynolds, R. H. Stansel.

Of the fifteen varieties of soybeans in the test, at Denton, only Manchu matured seed in 1937, producing 5.4 bushels per acre. However, Laredo and Easycook made the largest yields of hay, each producing slightly more than one ton of cured hay per acre. The yields of the other varieties ranged from 0.74 to 0.99 tons per acre. In the test on rates of seeding, the yield of hay increased as the rate of seeding was inceased from 20 to 50 pounds per acre. Inoculation did not increase the yield of hay.

E. B. Reynolds, P. B. Dunkle.

Germination and Longevity of Bitterweed Seed

This project was begun in November, 1931, to determine the viability and longevity of seed of the western bitterweed, *Actinea odorata,* which is a serious pest and a menace to sheep production on the ranges in the Edwards Plateau in southwestern Texas. Germination tests were made monthly from November, 1931, to November, 1936, on seed stored in the open and exposed to weather conditions and on seed stored in the Laboratory at the Ranch Experiment Station, Sonora. As stated in the 1936 Annual Report, both lots of seed had a viability of 72 per cent at the beginning of the test. Both lots of seed lost their germinating power with increasing age, but the seed stored outside deteriorated much more rapidly. At the end of five years, November, 1936, the seed stored in the open had decomposed and disintegrated to such an extent that satisfactory samples could not be obtained. Germination tests were discontinued at that time, although both lots of seed still contained a few viable seeds, but the germination was only a fraction of one per cent. The project was inactive in 1937.

E. B. Reynolds, V. L. Cory, W. H. Dameron.

Inheritance and Improvement in Sorghum

Milo selections rsistant to Milo Blight, or milo root rot *(Pythium arrhenomanes)*, were grown at the Lubbock and Chillicothe stations and on a tract of disease infected land leased for the purpose in Hardeman county. The latter was especially valuable in obtaining known exposure to the disease for many of the Dwarf Yellow milo selections, as well as other susceptible varieties and strains in which resistance is being sought. Milo selections Nos. 276, 277, 332, 338, 516, and 560 have been selected out of the large number grown as being not only resistant to Milo Blight but the best in other respects. These will be grown in comparative yield trials at several substations next year for further observation on their superiority and for increase. The area suffering losses from Milo Blight in the grain sorghum region of Texas is even more extensive this year than in the previous two years. Infection of milo on the High Plains this year was quite extensive, where yields were materially decreased. Illustrative of the losses in yield that may be expected from Milo Blight are yields from early planted milo on disease infected land leased in Hardeman county, where the resistant selection No. 217 produced 32.7 bushels and ordinary susceptible Milo 670 yielded 1.5 bushels to the acre. When the crop was planted later, losses were not so severe, as shown from the June 15th planting on mildly infected soil at the Chillicothe station, when resistant selections yielded 48.2 bushels, whereas the old susceptible Milo 670 produced 35.4 bushels.

Small quantities of seed of Blight resistant milo were distributed in 1937 to all certified sorghum seed growers to serve as foundation stock for further distribution to farmers. Approximately 25,000 pounds of seed of these new disease resistant strains were grown at the Lubbock and Chillicothe stations and distributed for seed.

From a large number of Early White, or 60-day, milo selections tested on diseased soil in the greenhouse during the winter of 1936-37, three resistant selections were recovered. These proved resistant in the field last summer and the best one is being increased for distribution. This resistant Early White milo has been crossed to Early Yellow milo, which is susceptible, in order to obtain a resistant strain of Early Yellow milo through hybridization and selection. Quadroon, a new and popular variety developed from a kafir-milo cross, was found to be susceptible to Milo Blight. A resistant strain of this variety has been developed from plantings made on badly infected soil at Chillicothe this year.

Darso is also highly susceptible to Milo Blight. The disease appeared in Darso plats on the Temple station this year, where it killed out 60 to 80 per cent of the crop in certain rotations. Selections were made from surviving plants and tested on diseased soil in the greenhouse. Among fifty-one selections tested a number were found to be resistant. Selections Nos. 8 and 21 have been chosen for increasing at the Chillicothe station next year in order to produce seed of resistant strains for distribution to farmers.

Results of studies to determine the degree and utility of hybrid vigor that could be obtained from crosses between certain varieties of sorghum and the most favorable combinations which might be used in the production of crossed sorghum seed for commercial planting, were published in the March issue of the Journal of Heredity. Certain combinations of crosses which do not give extreme lateness or tallness in the F_1 generation, but which produce marked increases in grain or forage yields, appear promising as a means of improving production of both grain and forage. Studies are being continued with additional crosses, as well as with procedure, to determine the most practical means of producing crossed seed in quantities. The use of male sterility in sorghum appears to be the most promising lead at the present time and experiments in this connection are being continued. Evidence of a new male sterile, linked with the yellow leaf tip character found this year, may prove useful in a practical way. If the linkage is complete, as it appears, all of the seed set on pollen sterile plants would be crossed seed and these recessives are distinctly marked with yellow leaf tip.

Sorghum breeding work on a more extensive scale continued throughout the year. A large number of desired crosses was made, both in the field and in the greenhouse. Greenhouse facilities greatly speed up the sorghum breeding program. When crosses are made in the field, the F_1 plants are grown in the greenhouse, and when crosses are made in the greenhouse, the F_1 plants are grown in the field, thus growing two generations in one year. Yellow-seeded strains of Hegari, kafir, and feterita are in the process of development by backcrossing to the parent after the factor for yellow seed has been introduced through hybridization with a yellow-seeded variety, such as milo. New yellow-seeded varieties with the undercoat in the seed absent, thus giving clean yellow color, is the objective. Along with seed color certain other characters, such as juicy and sweet stem, distinctive glume colors, and modified plant color carrying resistance to some common foliage diseases in sorghum, are being incorporated into some of the new varieties.

The breeding program with Sudan grass, with objectives of creating new strains having pithy, juicy and sweet stems, resistance to foliage diseases, nonshattering seed habits, and marked with distinctive glume colors, is progressing rapidly. Sudan grass and Leoti sorgo are the parents used and numerous strains, having the above characteristics and marked with distinctive red, sienna, and mahogany colored glumes, have been backcrossed to the Sudan grass parent from four to five times. The progeny must undergo further selection, and in some instances an additional backcross will be made. A number of these new strains are being tested for disease resistance in the more humid regions.

Breeding of new types of sorghum for popping purposes has been undertaken. A small-seeded, very flinty variety of sorghum grown in Haiti and known as Peti Mil, has been grown for several years but is so late in maturity that it has not been possible to make crosses when grown in the field. A number of crosses with common varieties, including Shallu, kafir, milo, and a very flinty, large-seeded kafir hybrid, have been made and the F_1 plants grown in the greenhouse in order to incorporate earliness and large seed along with the popping quality. Popping trials with this new flinty-seeded sorghum show a very high per cent of popping and an expansion ratio of about 1 to 7, on the average, as compared with an expansion ratio of 1 to 12 obtained from pop corn under the same conditions. The popped grains were small but the quality and flavor were good.

Among new characters which are being studied to determine their mode of inheritance and linkage relations are floury endosperm, shape of seed, papery glumes, vivipary, liguleless, shattering, length of rachis, and length of peduncle. Appropriate crosses have been made and the F_2 generation will be grown in the field next year.

R. E. Karper, J. R. Quinby, and D. L. Jones.

Breeding Small Grains for Resistance to Rust

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

This cooperative project between the Texas Experiment Station and the Division of Cereal Crops and Diseases of the U. S. Department of Agriculture has two main objectives. The first is to develop rust resistant varieties of the cereal crops, wheat, oats and barley, for South Texas, where these crops cannot now be grown on account of the prevalence of the cereal rusts. The second is to utilize the natural annual rust epidemics which occur at College Station in isolating rust-resistant strains for North Texas, Oklahoma, and Kansas. The work is part of a general cooperative undertaking designed to create a barrier of rust resistant varieties in the southern part of the winter wheat belt to prevent the northward spread of rust to the extensive cereal producing regions farther north.

All varieties and strains now known to carry factors for the various types of resistance are being assembled. These factors for resistance are being combined in new varieties to be used for foundation breeding stack. In addition, a search for new factors for resistance is being made among varieties from all of the principal cereal producing regions of the world. About 700 varieties of wheat of foreign origin were tested for rust resistance in 1937. Between fifteen and twenty of these showed resistance to stem rust, ranging in degree from moderate to fairly high.

In the breeding work with wheat, some decidedly practical results have already been obtained. Crosses between Hope, a rust resistant spring wheat, and Mediterranean No. 63 have given some intermediate spring-winter types that are practically immune to both rusts in the mature plant stage. Some of these new strains have been of outstanding performance for the past two years in the southern part of the Blackland Prairies and the Coast Prairie. Yields of the highest yielding strains at points where grown in 1937 were College Station, 17.3 bushels; Beeville, 25.3 bushels; Temple, 31.9 bushels. It should be noted that these yields were obtained in areas where bread wheat is not now grown.

An attempt is now being made to combine the mature plant resistance to stem rust of the Hope X Mediterranean strains with seedling resistance found in other wheats, and thereby obtain varieties on which stem rust cannot overwinter. This is a slow, tedious process since there are many factors for seedling resistance, each one of which may control resistance to only a few of the many known physiologic forms of the diease.

The oat breeding work at College Station, aimed at the production of rust resistant varieties, made satisfactory progress in 1937. New crown rust resistant strains tested at College Station, Denton, Beeville, and Temple gave very gratifying results in comparison with the standard Nortex. At Beeville, however, all of the strains were attacked by stem rust, and the yields of some of the later maturing strains were reduced considerably. This experience shows the importance of having resistance to both crown rust and stem rust in varieties of oats developed for growing in South Texas.

Certain new hybrid oat selections made in 1936 and grown in progeny rows at College Station in 1937 showed marked resistance to both crown rust and stem rust. Seed of these strains was increased sufficiently to allow for more thorough testing in 1938.

Barley usually ripens sufficiently early to escape severe injury by stem rust. However, since the forms of stem rust that occur on barley are also capable of attacking wheat, even light infections of stem rust in fields of barley early in the season are capable of spreading to adjoining fields of wheat and creating heavy infections there later in the season. Since the acreage seeded to barley in Texas is rapidly expanding, it appears, therefore, that an effective barrier against the northward spread of stem rust of wheat cannot be created without replacing the present susceptible varieties of barely with resistant varieties. Observations at College Station indicate, also, that the dwarf leaf rust of barley, heretofore considered of little importance, is capable of doing great damage to barley under the humid conditions prevailing in South Texas. Should barley growing for either pasture or grain become general in South Texas, it is possible that sufficient inoculum of this rust might be built up there during the winter and early spring months to create severe epidemics of the disease in the barley producing region farther north. Work in breeding for resistance to the barley rusts, therefore, seems to be justified. Some progress in breeding for resitance to stem rust in barley has already been made. In this work, resistance to stem rust obtained from Peatland, a spring variety, has been combined with the smooth awn of the Dryland variety. These two desirable characteristics are now being combined with winter hardiness by repeated backcrossing to our best strains of winter barley. At the same time, work is being started in breeding to combine resistance to leaf rust with winter hardiness.

E. S. McFadden, P. C. Mangelsdorf.

Effect of Fertilizers on Yield, Chemical Composition, and Botanical Composition of Pasture Herbage

(In cooperation with the Tennessee Valley Authority)

The object of this work is to determine the effect of fertilizers, especially phosphatic fertilizers, on the yield and chemical composition of pasture herbage. In 1937 experiments were conducted at College Station, Angleton, Lufkin, and Tyler. The fertilizer treatments were similar, but not identical, at the four points. A chemical analysis has been made on some of the samples of herbage, but the analysis is not complete and consequently the data are not available for this report.

In 1937 much higher yields of herbage were obtained in the experiment at College Station than at Angleton, Lufkin, and Tyler. This is probably due to the excellent growth of bur clover in the pasture mixture, and most of the herbage at the first two cuttings consisted of bur clover. The 80-40-40 treatment produced the highest yield, 11,440 pounds of air-dry herbage, which was 2806 pounds, or about 32 per cent more than the yield of the untreated soil. Most of this increase is due to the effects of potash and phosphoric acid. This treatment also made the highest average yield, 7246 pounds, or 1932 pounds more than the untreated soil, during the two years 1936 and 1937.

At Angleton in 1937 the work was conducted on a pasture consisting mostly of little bluestem grass, *Andropogon scoparius.* The following treatments expressed in pounds per acre of nitrogen, phosphoric acid, and potash, in the order given, were applied to the grass early in the spring: 0-40-0, 0-80-0, 20-40-0, 40-80-0, 40-40-0, and nothing. The 40-40-0 treatment made the highest yield of air-dry herbage, 3076 pounds, which was 461 pounds, or about 17 per cent more than the yield of the untreated plat. Nitrogen apparently had a greater effect than phosphoric acid on the yield of herbage, although the differences in yield among the several treatments probably were not significant. Most of the increases in yield obtained during the two years 1936 and 1937 are attributed to applications of nitrogen rather than to phosphoric acid.

The experiment at Lufkin was started on a pasture consisting mostly of Bermuda grass, carpet grass, lespedeza, and white clover, in the spring of 1937. The fertilizer treatments were similar to those used at the other stations. All of the seven fertilizer treatments used produced larger yields of herbage than the untreated soil. Application of potash made larger increases in yield than applications of either nitrogen or potash. For example, the addition of 24 pounds of potash to the 35-58-0 fertilizer increased the yield from 3913 pounds of air-dry matter per acre to 5360 pounds. This is an increase of 1393 pounds, or about 35 per cent, for the potash. This larger yield is no doubt due in part to the stimulation of the growth of legumes by the potash. The complete fertilizer, the 70-58-24 treatment, made the highest yield, 5360 pounds per acre, which is 1821 pounds, or 51 per cent more than the yield of the plats which received no fertilizer.

The work at Tyler was started on a pasture consisting mostly of Bermuda grass in 1937. Only two cuttings were made, June 11, and August 19, and lower yields were obtained at this point than at the other points. The average yield of all of the nine treatments used was 904 pounds of dry matter per acre, which is somewhat lower than the yields obtained at the other stations. Applications of 116 pounds and 232 pounds of superphosphate (equivalent to 40 and 80 pounds of P_2O_5) had a greater effect on yield of herbage than applications of 100 and 200 pounds of sulphate of ammonia. The treatment consisting of 200 pounds of sulphate of ammonia and 232 pounds of superphosphate (40-80-0) per acre made the largest yield, 988 pounds of absolutely dry matter per acre, or 33 per cent more than the unfertilized soil.

E. B. Reynolds, G. S. Fraps, R. L. Hensel, J. H. Jones.

Improvement of Range and Pasture Plants

Work on this project was carried forward actively during the year. A two-acre nursery was established where water for irrigation purposes is available. The plat is adequately fenced and drainage ditches have been provided. Twelve hundred 4-foot plats with 18-inch alleys and 100 test rows have been laid out and permanently staked. On account of the difficulty of removing trees and brush it was not possible to get the nursery in shape for planting until September 1.

One thousand de-hulled buffalo grass seed from Temple and a similar number from Chillicothe were planted in flats in the greenhouse in December, 1936. In March these were large enough to transplant into pots. The germination percentage for the Temple seeds was 43.5 and for Chillicothe, 49.4. On account of unfavorable weather conditions, particularly sunshine, growth was not as rapid as it should have been, so that it took approximately four months for the first runners to form. Measurements show that the Temple plants have thicker runners, that there is an appreciable difference in the length of the internodes and length and width of leaves in this strain over the Chillicothe. The former seemed to possess more vigor at all times. Both types show a great variation in the individual plants. These vary from healthy, heavy-foliaged types to very fine leafed ones, as well as the ones which are obviously weak. Prior to transplanting to the field out of 367 Temple plants, 46 were classed as vigorous, 254 average, 17 weak, and 50 discarded. The figures for the Chillicothe plants were: out of 339 plants, vigorous 4, average 181, weak 62, and discarded 92.

All of the living plants were transplanted to the nursery on September 1. Soil and moisture conditions were so unfavorable, since no rain had fallen after May 6, that the plants were thoroughly watered when moved to the field and at intervals thereafter as conditions demanded. All of the plants survived, but some made practically no growth. On November 30 a record of the amount of growth made by the plants showed that the average Temple plant occupied an area of approximately 1¼ square feet, while the Chillicothe plants averaged only ½ square foot.

The number of plants which produced inflorescence during the first year of growth was very small, since only 100 Temple plants and 34 Chillicothe plants did so. The ratio of male plants to female plants was 2 : 3 in the Temple strain and 1 : 3 in the Chillicothe. In addition, the Chillicothe strain produced three monoecious plants. There seems also to be a difference in the two strains with respect to winter dormancy, for on November 30, 68 of the Temple plants and only 20 of the Chillicothe plants were still green and growing actively.

Seed from various sections of the Great Plains have been secured and planted and will be studied to determine if any one strain possesses distinct, desirable qualities which may be developed for use in the state.

R. L. Hensel.

Limiting Factors in Pasture Production

The work with pasture fertilizers at College Station indicates that a combination of nitrogen and phosphorus continues to give the highest returns, while nitrogen alone does not show significant response. On account of the very unsatisfactory rainfall conditions in the late spring, summer, and early fall only four cuttings were made, namely, in February, April, May, and July. The July cutting was very light and was the only one in which grasses predominated. The other cuttings were practically pure bur clover, so the results show the effect of the treatment on bur clover and not on the grasses.

Similar treatments at Lufkin inaugurated during the year indicate that the greatest response was secured from fertilizers containing phosphorus in that the growth and spread of clovers was enhanced. The addition of varying amounts of oak wood ashes also stimulated the growth of clovers.

Mowing of pastures at Angleton has kept weeds and worthless grasses in check and has aided in the spread of carpet grass, lespedeza, and clovers, thereby increasing their nutritive value and carrying capacity.

R. L. Hensel.

Management of Grazing Lands

Observations made at Lufkin indicate that the daily rotation of series of eight small pastures of approximately five acres each makes them highly productive and capable of maintaining livestock in good condition. These pastures consist of carpet grass, lespedeza, white Dutch clover, and a small amount of Bermuda, Dallis, and Vasey grasses. In the period from March to November they carried twenty-six mature cows, seventeen calves, and one bull, in addition to producing 200 bales of carpet grass—white Dutch clover hay of fine quality. Additional grazing could have been secured during the winter months had the pastures not been so soggy because of winter rains. To overcome this a 12-acre upland field was planted to oats and vetch with the plan in mind of grazing this during the time the bottom land pastures were too soft. A satisfactory stand was not secured; hence the plan was largely unsuccessful. Similarly, the same field was planted to Sudan grass in the summer in the hope that this could be cut for hay and used as winter feed. The dry summer caused such poor growth of Sudan grass that it was not worth while to save the crop.

The heavy rotation grazing does not seem to have affected the reseeding of lespedeza and white Dutch clover.

R. L. Hensel.

Flax as a Winter Crop in South Texas

(In cooperation with the Bureau of Plant Industry, U. S.
Department of Agriculture)

In response to the urgent need of increased domestic production of flaxseed, the possibility of growing flax as a winter crop in South Texas is being investigated. For the past three years, experimental plantings have been made over a wide area in South Texas, including the experiment stations at College Station, Angleton, and Beeville and several farms along the Gulf Coast. The results of these preliminary experiments indicate that flax may be adapted to growing as a winter crop throughout a large part of South Texas, particularly on the better soil types along the Gulf Coast from Houston west and south to the Rio Grande Valley. The best yields have been obtained in the region centering around Beeville and Victoria. In a three-year test at Beeville, the highest yielding variety (Abyssinian Yellow) among the seven varieties tested gave an average yield of 19.9 bushels per acre. At Victoria, the average yield of the best variety (Rio) for a two-year period was 14.3 bushels. In replicated tests at College Station, Angleton, Beeville, Beaumont, Sugarland, Hallettsville, and Victoria, covering periods of one to three years and representing a total of eleven crop years, the average yield for all varieties has been 9.0 bushels per acre, with 10.7 bushels for Rio, the leading variety. The average yield of the Rio variety in these tests is nearly twice the average yield of flaxseed in the United States for the five-year period ending in 1936.

One of the most important characteristics of a flax variety for growing as a winter crop in the greater part of South Texas is the ability to withstand temperatures below the freezing point. Very marked differential reactions to low temperatures have been observed among the varieties grown at College Station for the past two years. The Punjab variety, which is grown extensively as a winter crop in the Imperial Valley of California, has been severely injured by frost at College Station during both of the past two years. On the other hand, Bolley's Golden, has shown marked resistance to frost during both years. Bison, Rio, N. D. 114, and Linota also show considerable resistance to frost.

In several of the experimental plantings along the Gulf Coast, the need of better surface drainage was evident. In most cases, it is probable that plowing with the slope of the land so as to allow drainage to take place down the dead furrows would have given sufficient surface drainage to meet the requirements of the crop.

The oil content of the flaxseed produced in these experimental plantings has been fully as high as that of seed grown in the principal producing areas elsewhere in the United States. The drying property of the oil, as determined by the iodine number, is well above that of the oil obtained from the usual commercial run of flaxseed.

These preliminary tests indicate that when careful attention is paid to such points as choice of variety, time of seeding, and surface drainage, the per acre yield of flaxseed from fall seeding on the better soil types of South Texas can be expected to run somewhat above the average for the United States, while the quality of the seed, based on either the oil content or the drying properties of the oil, can be expected to be fully up to the standards of seed produced elsewhere in the United States.

E. S. McFadden, P. C. Mangelsdorf.

MAIN STATION AGRONOMY FARM

The Main Station Agronomy Farm is located on the land of the Agricultural and Mechanical College of Texas at College Station, Brazos County, and comprises 94 acres of land, of which 67 acres is used for experimental purposes and the remaining acreage for building, pastures, and roadways, and for production of seed of superior strains of crops developed on the farm.

Rotation, Fertilizer, and Soil Improvement

This work consists of a four year rotation of corn, cotton, oats, and cowpeas in comparison with continuous cotton and corn. Seven fertilizer treatments are used on both the rotated and the non-rotated areas. These treatments are superphosphate, rock phosphate, superphosphate and manure, rock phosphate and manure, superphosphate and cottonseed meal, manure alone, and removal of crop residue, and no fertilizer treatment.

During the twenty-four year period (1914-1937) the treatment of superphosphate and manure gave an average yield of 229 pounds of lint cotton to the acre, and the treatment of manuer alone gave an average yield of 228 pounds of lint cotton to the acre in the rotated cotton, against 205 pounds of lint cotton for the manure and superphosphate treatment and 228 pounds to the acre for the manure alone in the continuously-planted cotton.

The average yield of the plat which received no treatment and from which the crop residue had been removed was 165 pounds of lint cotton to the acre for the rotated cotton, and 176 pounds of lint cotton for the continuously planted cotton.

For the same period, the treatment of manure gave an average yield of 24 bushels of corn to the acre, while the manure and superphosphate gave 23 bushels in the rotated corn, against 17 bushels for the manure and superphosphate, and 16 bushels for manure alone in the continuously-planted corn.

The average yield of the plat which received no treatment and from which the crop residue had been removed, was 18 bushels for the rotated corn, and 12 bushels for the continuously-planted corn.

For the twenty-two year period (1916-1937) cottonseed meal and superphosphate produced the highest yield of oats, 16 bushels to the acre, while the plat which received no treatment and from which the crop residue had been removed produced 14 bushels to the acre. Manure alone and superphosphate and manure only made a slight increase of a bushel to the acre over the untreated plat.

During the twenty-four years, plats which received no fertilizer treatment of any kind produced an average yield of 167 pounds of lint cotton per acre in the rotation and 185 pounds where cotton was grown on the same land each year. Rotated corn on plats which received no fertilizer made an average yield of 19 bushels per acre during the twenty-four years, while the non-rotated corn produced 12 bushels to the acre—a gain of 30 per cent for the rotated corn.

Soil Fertility Studies

The Fertility Test consists of a three year rotation of oats, cotton, and corn in which a 4-12-4 commercial fertilizer at the rate of 400 pounds to the acre is used as the standard treatment, and each element—nitrogen, phosphoric acid and potash—is varied in turn while the other two are kept constant. The 4-12-4 fertilizer is also used at rates of 200, 400, 600, and 800 pounds to the acre.

In 1937 the average yield of all plats receiving a treatment of 400 pounds of a 4-12-4 fertilizer was 313 pounds of lint cotton to the acre. The plat receiving a treatment of 800 pounds of 4-12-4 to the acre produced 369 pounds of lint cotton, while the plat receiving no fertilizer treatment produced 209 pounds. During the ten year period (1928-1937) the treatment of 12 tons of manure and 400 pounds of superphosphate to the acre produced 364 pounds to the acre, while the average yield of the plats receiving a treatment of a 4-12-4 at the rate of 400 pounds to the acre was 299 pounds of lint, and that of the plat receiving no treatment was 215 pounds.

In 1937 the plat receiving 400 pounds of 4-12-4 to the acre produced the highest yield of corn, 26 bushels to the acre, while the treatment of 400 pounds to the acre of a 4-12-0 fertilizer produced 24 bushels of corn to the acre. The plat receiving no fertilizer treatment produced 22 bushels. During the eleven years of the test, the treatment of 12 tons of manure and 400 pounds of superphosphate to the acre produced the highest average yield of 31 bushels of corn to the acre, while the plat receiving no treatment produced 22 bushels.

In 1937 the plat receiving the treatment of 800 pounds of a 4-12-4 fertilizer to the acre produced 31 bushels of oats to the acre, while the plat receiving no fertilizer treatment produced 14 bushels. For the eleven year period the plat receiving a treatment of 400 pounds to the acre of a 4-12-4 fertilizer produced the highest average yield, 21 bushels of oats to the acre, while the plat which received no fertilizer treatment produced 16 bushels to the acre. The average yield of oats for the plats which received the standard treatment of a 4-12-4 fertilizer over the period of years was 18 bushels to the acre.

Soil Fertility and Spacing Test

The purpose of this test is to determine what stand or number of cotton plants spaced 12, 18, and 24 inches apart on a 36 inch row in poor, medium, and fertile soil would give the best yields of lint cotton on each type of soil. The poor soil was not fertilized, the medium soil received

400 pounds of a 4-8-4 fertilizer to the acre, and the fertile soil received 800 pounds to the acre of the same fertilizer.

On the poor soil in 1937 the 12 inch spacing produced the highest yield of lint cotton, 225 pounds. In the medium soil the 18 inch spacing produced 275 pounds of lint cotton to the acre, but the 12 inch and the 24 inch spacing each produced 265 pounds of lint.

On the fertile soil, the 12 inch spacing produced 309 pounds, the 18 inch spacing 301 pounds, and the 24 inch spacing 269 pounds of lint cotton to the acre.

Polyhalite as a Source of Potash

The availability of the potash in polyhalite was compared with that of the potash in muriate of potash. This was done by making two complete fertilizers one with a 4-8-6 and the other a 4-8-4.

The soil treated with the white polyhalite made the largest average gain, yielding 315 pounds of lint cotton to the acre, which is four pounds more than the 4-8-4 and 98 pounds more than the 4-8-6 fertilizer. The red polyhalite also produced 65 pounds more lint cotton than the untreated plat.

Cotton Variety Test

Of the fifty varieties tested in 1937 the three varieties producing the highest average yield of lint from the six replications were Mebane 804-50 241 pounds, Acala N 28-5, 210 pounds, and Lone Star (Gorham) 202 pounds of lint cotton to the acre.

On the basis of comparable yields, the highest yielding varieties among those that have been grown for 10 years or more are: New Boykin, 240 lbs., Ferguson 406, 229 lbs., and Sunshine 216 lbs. of lint cotton to the acre.

Startex No. 618, which has been grown seven years (1931-1937), produced an average yield of 232 pounds of lint cotton to the acre. This selection, developed on the station, has been a constant high yielder each year, and gives a comparable yield for the ten year period of 235 pounds of lint.

Regional Cooperative Cotton Variety Test

This test is conducted in cooperation with the Division of Cotton and other Fiber Crops of the Department of Agriculture and the Textile Foundation. Sixteen standard varieties of cotton were planted in eight replications, the test to cover three years, (1935-1937). Similar tests with the same varieties were conducted in the other cotton growing States.

Startex No. 619, a product of the Texas Agricultural Experiment Station, produced the highest average yield of lint cotton, 260 pounds to the acre.

Regional Cotton Variety Wilt Study

This test was conducted in cooperation with the Division of Plant Pathology and Physiology and the Division of Cotton and other Fiber Crops and Diseases of the Department of Agriculture. Twelve standard varieties were planted and replicated nine times. The varieties showing the greatest percentage of wilt were Half and Half with 29.6, Coker No. 100 29.5, Dixie Triumph 12, with with 24.4, and Cook 307 with 5.8 per cent, while Sea Island was entirely free from wilt.

Fertilizer Placement Test and Treatment Test

Fertilizers were placed at various distances and amounts to determine the effect on the germination of the seed and the growth of the plant. The treatment of cotton seed with various chemical dusts did not show any significant results. These tests were conducted by the division of Agricultural Engineering, and are reported fully in that division's report.

Green Manure Test with Cotton

Vetch was planted in the autumn for the green manure to furnish the nitrogen in comparison with vetch and 4-8-4 fertilizer, vetch and 0-8-4 fertilizer, a 4-8-4 fertilizer, and untreated plat. Each treatment was replicated six times. The vetch was plowed under in the spring and the commercial fertilizer applied about ten days before planting the cotton.

The vetch alone produced 233 pounds; the 4-8-4 fertilizer, 278 pounds; and the untreated plat, 186 pounds of lint cotton to the acre. The plats receiving an application of 4-8-4 and 0-8-4 fertilizer produced 261 and 267 pounds respectively of lint cotton to the acre.

Oats Variety Test

Varietal experiments with oats consisted of a single row nursery of miscellaneous hybrid selections grown in comparison with Alber, Bond, and Nortex. The selections were largely from crosses of Bond and Victoria with standard commercial varieties of Red oats made with the object of combining resistance to crown rust with desirable characteristics of the commercial varieties. The rows were thirty feet in length, and the checks of Alber, Bond, and Nortex were inserted following every tenth selection.

Many of the selections produced better yield of grain of good quality than the checks. The most promising of these will be further tested. This work is being conducted in cooperation with the Office of Cereal Investigation of the Department of Agriculture.

Peanuts

The Macspan peanut was planted this year for increased yield for distribution to farmers for the production of pure seed. For a seven year period the Macspan peanut was the high yielder of the Spanish type, with a yield of 31.7 bushels to the acre.

Ten varieties of peanuts were planted in the variety test. The high yielder, Java Toeban, produced 46.5 bushels of peanuts to the acre, and for the five year test Improved Spanish produced the highest average yield of 41.7 bushels to the acre. Java Toeban produced 37.4 bushels for the same period of years.

Soy Bean Variety and Date Test

The following varieties of soybeans were planted in 1937 on three planting dates: Easycook, Avoyelles, Biloxi, Tokio, Creole, White Biloxi, Delnashat, Laredo, Mamredo, Mamloxi, Manchu, Mammoth Yellow, Palmetto, and Oo-too-tan. Of these fourteen varieties two only produced seed in small amounts; Manchu, 2.6 bushels to the acre and Mamredo 1.7 bushels to the acre.

All of the varieties, with the exception of the Manchu and the Mamredo, made good vegetative growth, but failed to produce seed pod.

Increase of Pure Seed

Both in 1936 and 1937 seventeen acres were planted in Yellow Surcropper. This corn has been certified, and the demand from all parts of the State was far greater than the supply.

Increased plantings were also made of Startex Cotton No. 619, as well as Red Wonder cowpeas, in order to make distribution of these crops to farmers, and to increase the production of pure seed for further introduction through the State.

Geo. T. McNess.

PLANT PATHOLOGY AND PHYSIOLOGY

Cotton Root-Rot

Cotton root rot in Texas in 1937: Estimates of losses to the 1937 cotton crop from root rot were made on September 20-24 for 770 fields, in 22 counties. For the entire area covered, losses were below normal, in accord with the general low precipitation during the growing season. Mean percentages of cotton plants killed at this time in different counties varied from 0 to 29.1 per cent. For different portions of the state, the reduction in yield due to the disease was estimated at 0 to 12.1 per cent, and for the entire state, the loss was estimated as about 5.9 per cent of the expected yield in the absence of root rot, or about 300,000 bales.

Presence of root rot in Hall County was confirmed by specimens received from Memphis. The disease has now been reported from 200 of the 254 counties of Texas.

W. N. Ezekiel.

Conditions affecting local prevalence of root rot: Study by multiple correlation of root-rot losses in ten selected counties, in which the soils are approximately equally favorable for the disease, showed the important effect of April, May, June, and July rainfall, and the normal mean annual temperature. A value of R = .86 was obtained. An increase of 1 inch of rainfall in April or May was associated with an increase of about 15 per cent of root rot; 1 inch of rainfall in June with about 20 per cent increase in root rot; and 1 inch additional in July with about 31 per cent increase in root rot. The differences in August rainfall were apparently without effect on the percentage of root rot in September.

Increase in the mean normal temperature of about 1° F. was associated with an increase of about 1.1 per cent of root rot. Similarly, considering large sections of the state, the disease is absent in the northwest portion, and becomes progressively more prevalent toward the south, in accord with the higher temperatures. Root rot is not prevalent in sections of Texas with a mean normal temperature below about 60° F.

Presence or absence of root rot in different sections of Texas seems to be determined largely by the relative prevalence of favorable neutral to slightly alkaline soils, and high mean temperatures. Destructiveness of the disease within any particular period is then limited chiefly by the rainfall. For the cotton crop in 1937, rainfall from April through July was apparently the important factor.

W. N. Ezekiel.

Life History of the Root-rot Fungus

The Phymatotrichum spore stage: Attempts were made to produce the spore-mat stage in the laboratory. Among methods tested were growing the fungus in cultures on soils of various types, with and without original additions of lime, cornmeal, or synthetic nutrients, with and without periodic additions of sterile distilled water and sterile synthetic nutrient solutions to adjust the soil moisture in various ways, and with and without irradiation through Cellophane caps. Under some of these conditions accompanying cultures of Coprinus, Lepiota, and Poria produced sporophores, but no special growth was obtained with *P. omnivorum.*

Spores of *P. omnivorum* collected in the field in Brazos County during the year were usually irregularly oval in shape, and averaged 3.7-3.8 by 5.1-5.8 microns in size. Germination of spores was attempted with various media prepared from synthetic materials and also from natural sources, including proteose-peptone and grated carrots, with immature, mature, and aged spores used as the inoculum and with various densities of inoculum in the drop cultures. In one series, spores were tested in large modified Ward cells prepared from paraffin blocks, providing 50 cc atmosphere respectively of air alone, or with 25 per cent, 50 per cent, 75 per cent, and 100 per cent of oxygen substituted. In some of the series, fields of spores were drawn and measured periodically to note possible enlargement of individual spores. No germination was noted, except in two series in which single-spore isolations later proved that growth was coming not from spores of *P. omnivorum,* but instead from contaminating spores of other fungi. Contaminant spores of this kind are found sometimes in rather large proportion among Phymatotrichum spores; and reports of germination of Phymatotrichum spores are to be considered somewhat critically unless the resultant growth has been identified and proved not to come from intermixed spores of some contaminant.

Spore mats of *P. silvicola* Taubenhaus and Watkins were prevalent and were again studied. These spores were found usually spheroid, averging 3.5-5.1 by 4.0-5.7 microns in size. None germinated in several tests. Isolations from the spiculate mats on two occasions yielded cultures of *Ozonium texanum* Neal and Wester. In drop cultures, this Ozonium was later found to develop typical clamp connections. This is of interest in view of the close analogies between this fungus and *P. omnivorum.*

W. N. Ezekiel.

Some Basidiomycetes found associated with the root-rot fungus: Several Basidiomycetes have been found frequently associated with plants killed by root rot; and one Basidiomycete, culture 24-s-2, has appeared in transfer of a strain of *P. omnivorum* previously carried in artificial culture for more than six years. This Basidiomycete 24-s-2, *Poria ambigua, Lepiota cepaestipes, Ozonium auricomum (Coprinus radians), Ozonium texanum,* and *Phymatotrichum omnivorum* strain 43, were grown in all possible combinations in drop cultures inoculated simultaneously at two different points. Definite anastomosis was found only between 24-s-2 and *P. omnivorum,* confirming previous observation of such fusion between this Basidiomycete and other strains of the root-rot fungus. These results support the possibility that 24-s-2 may be the perfect or sexual spore stage of *P. omnivorum.*

W. N. Ezekiel.

Physiology of the Root-rot Fungus

Studies on the cause of immunity of monocotyledonous plants to Phymatotrichum root rot: Root rot attacks nearly two thousand gymnosperms and dicotyledonous plants, while monocotyledonous plants are immune. Experiments summarized in the Journal of Agricultural Research, 56:773-786, 1938, have proved that this immunity is due at least in part to the presence in roots of these plants of minute quantities of acidic, ether-soluble substances. Fractions of this nature, prepared from onion bulbs, Gladiolus corms, and giant reed, canna, Hemerocallis, and Johnson grass roots, are 100 times as potent as the original plant juice in preventing growth of the root-rot fungus.

W. N. Ezekiel, J. F. Fudge.

Variation and dissociation within the root-rot fungus: Variation and dissociation of *Phymatotrichum omnivorum* in pure culture have been reported. In 1935, a root-rot-proof container was constructed of sulphur slabs, filled with soil and planted with cotton. A pure culture of the fungus was introduced the same year, and reisolations have been made periodically from the root-rot infected plants to determine whether any change had occurred in the fungus. Comparisons of some strains reisolated during 1937 with the original strain showed no consistent difference, except slower growth.

One strain of *P. omnivorum* that had been carried in artificial culture for a number of years showed several years ago decided reduction in rate of growth. It continued to produce buff-colored strands and profuse sclerotia but grew so slowly as to preclude further use in certain experiments. This strain has been periodically retransferred in the hope of obtaining again a more rapidly-growing dissociant. Finally, in May, 1937, such transfers were found growing approximately as rapidly as when the culture was first isolated eight years previously. Strain 24-s-1 has since been transferred repeatedly and has maintained fairly rapid growth.

In a study of rate of growth, particularly with some lines of 24-s-1, extension of colony diameter in flask cultures was found a highly variable characteristic. It was affected by the mass of inoculum, a mass of approximately one tenth the usual size, whether consisting of hyphal or sclerotial portions from the parent culture, yielding greatly reduced growth, whether transplanted to agar, liquid, or cotton-stem substrata. It was affected by the type of material used to establish the transplant, sclerotial material from the same parent culture yielding transfers that grew more rapidly than those established with hyphal material. Comparing different strains, the rate of growth did not correlate with production of sclerotia. Rapidly-growing strains apparently were no more likely to produce sclerotia than slowly-growing strains.

It seems reasonable to suggest that "attenuation" reported by some workers is not a necessary result of the length of time strains of *P. omnivorum* are carried in artificial culture so much as accidental and not necessarily permanent change in the highly variable growth rate.

W. N. Ezekiel.

Effect of copper, iron, and mercury on growth of root-rot fungus in solution cultures: This report is included under Substation No. 5.

Growth of Phymatotrichum omnivorum on decoctions prepared from roots of various woody plants: Decoctions were prepared from pulp of bark, wood, and whole root portions of roots of yaupon, retama, mesquite, sour orange, Turk's-cap Hibiscus, chinaberry, sweet lime, hackberry, pomegranate, Berlandieri grape, Champini grape, and Dogridge grape. The decoctions were variously augmented by the addition of sugars and nutrient salts and also diluted. A total of 2232 flasks of the variously altered decoctions were sterilized, inoculated with pure culture sclerotia, and incubated at room temperature for six weeks. At the fourth, fifth, and sixth weeks determinations were made of the pH of the decoction and the dry weight of the fungous mat in each flask. In decoctions from all except two of the above 12 species the fungus showed a clear response to nutrients. Growth was more abundant in decoctions to which had been added sugars and nutrient salts, and growth decreased in the dilutions. The two exceptions were sour orange and sweet lime. In decoctions from bark and whole roots of these plants there was no growth upon the undiluted decoctions, regardless of the amount of nutrients added. In diluted decoctions with or without added nutrients moderate growth occurred. This suggests the presence in the bark of sour orange and sweet lime roots of some substance or substances which inhibit the growth of the fungus.

J. J. Taubenhaus, P. Macy, G. M. Watkins.

Cytology of the Root-Rot Fungus

Cytological studies on Phymatotrichum omnivorum: This work has been continued with the further accumulation of slides showing the nuclei in hyphae, conidiophores, and conidia from spore mats fixed in various stages of development, and in hyphae from pure cultures of the fungus on liquid media. The data at hand thus far are not considered sufficient for final publication.

G. M. Watkins.

Cytology of host-parasite relations in field infections of cotton root rot: During the summer of 1937 repeated collections were made of cotton roots in various stages of attack by the root-rot fungus. Such roots were brought to the laboratory and sectioned while still fresh by means of a sliding microtome. The sections were stained in various ways and mounted on slides for microscopic study.

Transverse and longitudinal sections show that the fungus forms hyphal wefts which grow over the surface of the root and frequently accumulate in the superficial crevices which result from the rupture and sloughing-off of the external cork layers. The periderm cell walls in immediate contact with hyphal agglomerations soon begin to show changes in structure, color, and thickness which suggest chemical action upon them by substances possibly liberated from the actively growing hyphae. Breaks occur in such walls which permit the fungus to invade the newly opened cell cavities. As this process continues the number of invaded cells increases and the fungus thus progresses slowly through the periderm. The center of the lesion is occupied by a compact hyphal mass which contains in its interior the engulfed remnants of partly destroyed cork walls. After having penetrated the phellem, the mycelium spreads rapidly through the phellogen, phelloderm, phloem, and cambium, causing widespread collapse and disintegration of cells, and enters the woody cylinder. The passage of hyphae from cell to cell of the xylem is chiefly through pits, since the lignified walls of these cells are not readily broken down by the fungus.

G. M. Watkins.

Strand formation in Phymatotrichum omnivorum: In view of the relation of strand formation to the invasion of host roots by the root-rot fungus a renewed study of the process has been undertaken. Strand formation has been observed to occur in the same way on infected cotton roots, in pure cultures of the fungus, and among hyphae developing from sclerotia. The mycelium is composed of large hyphae with numerous repeatedly ramifying lateral hyphae of progressively smaller diameter. Some of the small hyphae make contact with the larger at irregular intervals and begin to grow over their surfaces. The process continues until the central hypha in each case is covered with a more or less compact pseudoparenchyma. Subsequent layers of cells are deposited in the same way upon the strand.

C. H. Rogers, G. M. Watkins.

Experiments on the Control of Cotton Root Rot

Growth of Phymatotrichum omnivorum in soils to which various quantities of crude ptroleum had been added: Samples of Miller clay loam, Yahola very fine sand, and Houston black clay soils were mixed with crude petroleum in the following ratios: no oil, 0.5 per cent of oil by weight, 1.5 per cent of oil by weight, and 2.5 per cent of oil by weight. Each treatment was replicated 4 or 5 times and all jars were inoculated with sclerotia of *P. omnivorum.* Measurements of the lateral development of strands from the points of inoculation were taken in all jars after 30 and 80 days. Although there were irregularities in the trends of the data, the measurements show definitely that the fungus is inhibited in soil containing petroleum. In most series practically no growth occurred in soil containing 2.5 per cent of oil.

J. J. Taubenhaus, G. M. Watkins.

Number and viability of sclerotia from four-year rotations of cotton, oats, sorghum, and corn:

Number and viability of sclerotia from four different two-year rotations:

Effect of clean fallow and continuous cotton following clean fallow on the number and viability of sclerotia:

Effect of continuous sorghum on number and viability of sclerotia:

Effect of seven years clean fallow on root rot and yield of cotton:

Effect of continuous sorghum on root rot:

Residual effect of different chemicals and previous crop on cotton yield and on root rot:

Resistance tests of cowpeas and cotton:

These items are included under report of Substation No. 5.

Barriers to prevent spread of root rot: Containers built in the soil of sulphur slabs, loosely fitted together, and with similar slabs for a bottom, have kept root rot out for four years. Cotton planted yearly inside the container remains free of root rot although the disease is widespread all around the container. In a similar container, with sides two feet deep but no bottom, plants were attacked by root rot during the first summer. For use in special locations where susceptible plants are to be grown on a small scale in the presence of root rot, or for experimental purposes, sulphur slabs seem to provide an excellent material for construction of root-rot-proof containers in the soil.

J. J. Taubenhaus, W. N. Ezekiel.

Relation of Soil Acidity to Cotton Root Rot

Studies carried on for a number of years on the relation of the acid or basic reaction of the soil to root rot were analyzed and brought together in Bulletin 545. These experiments proved that soils originally acid, or made acid by additions of various chemicals, are less favorable for infection of plants by the root-rot fungus, and are less favorable for continued survival of root rot from year to year, than are soils originally neutral to slightly alkaline or made so by chemical additions. This relation of acid soils to root rot is not necessarily due directly to the hydrogen-ion concentration, but is associated more closely with this factor than with original differences in soil types, for example.

Practical application of soil acidification to the control of root rot is still in the experimental stage. It is impracticable to acidify highly calcareous soils. In a number of experiments, the acidity of the surface soil seemed of particular importance, and it is suggested that for non-calcareous soils, further experiments should be performed to determine the value of repeated surface applications of small amounts of sulphur.

J. J. Taubenhaus, W. N. Ezekiel, J. F. Fudge.

Regional Cotton Variety Wilt Study

This study was conducted in cooperation with the Division of Agronomy and the Division of Cotton and Other Fiber Crops and Diseases, Bureau of Plant Industry. The purpose was to determine the relative resistance of different varieties to cotton wilt when grown in wilt-infested soils in different parts of the cotton belt. The effect of application of different kinds and amounts of fertilizer on the incidence of Fusarium wilt was also tested.

Two tests were made in Texas in 1937. One was planted on the main Station Farm at College Station and the other at Jacksonville, Texas. Each planting consisted of twelve varieties replicated nine times. The varieties were representative of wilt-resistant and susceptible types commonly grown in the wilt-infested regions of the eastern part of the cotton belt.

At College Station, Texas: In the test at College Station, the planting was made on Lufkin fine sandy loam without the addition of fertilizers. A good stand of plants was obtained with all varieties. Early in the summer several varieties showed definite signs of potash deficiency. Counts were made to determine the percentage of plants affected by wilt. On July 16 the wilted plants were determined on the basis of external symptoms only, while the September 10 count was based on the presence of internal discoloration of each plant.

Percentages of plants affected by wilt ranged from 0 per cent for Sea Island to 29.6 per cent for Half and Half. Cook 307, Toole, and Clevewilt, appeared to be quite resistant to wilt, the percentage of plants infected ranging from 5.8 per cent to 11.6 per cent.

A record was made of the rate of flowering of each variety to determine the relative earliness of maturity. Dixie Triumph produced the largest number of flowers earliest in the season.

All varieties except Half and Half produced tenderable length of staple ranging from 7/8 inch for Cook 307 to 1 5/16 inch for Sea Island. The highest yield was made by Cook 307 with 235 pounds of lint per acre, followed by Dixie Triumph 55-85 yielding 214 pounds per acre; Coker 100, 209 pounds; Sikes WR Staple, 191 pounds; Miller and Clevewilt 6, each 190 pounds. The lowest yield was made by Sea Island with only 16 pounds of lint per acre.

J. J. Taubenhaus, D. T. Killough.

At Jacksonville, Texas: The cotton at Jacksonville in the Regional Variety Wilt Test was grown on a sandy-red-iron-ore soil, with the fertilizers added according to the plan. It was observed that the resistant varieties and the potash fertilizer almost completely controlled the wilt disease. In contrast, an unfertilized field adjacent to the test plat showed an increase of 25 per cent more wilt this season than last (1936).

The yield of the varieties under test was about 1/2 bale of lint cotton per acre. The Sea Island variety showed resistance to wilt, and held its leaves longer, but shed its bolls earlier than the other varieties under drought conditions.

Symptoms of potash deficiency were abundant in rows fertilized with 6-8-0 on sandy land, but were absent from plants fertilized with a 6-8-8 fertilizer.

Miller 610, Cook 144, Toole, Clevewilt, Dixie Triumph 12, Dixie Triumph 14-5-2, and Dixie Triumph 55-85 all produced large yields of long staple seed cotton and showed desirable resistance to *Fusarium vasinfectum.* Compared to Half and Half, these varieties produced 20 to 35 per cent more cotton of a staple at least 1/4 "greater length."

P. A. Young.

Effect of foliage dusts and sprays on the yield and control of foliage diseases of cotton: The best control of angular leaf spot and Cercospora leaf spot of cotton was obtained by dusting the plants with a mixture of 8 parts sulphur, 1 part Cuprocide, and 1 part Paris green. Substituting basic copper sulphate for the Cuprocide or calcium arsenate for the Paris green did not affect the control of angular leaf spot but decreased the control of Cercospora leaf spot. Sprays containing Cuprocide 54 controlled both leaf spots and a spray containing basic copper sulphate controlled angular leaf spot. Sulphur or arsenicals alone slightly reduced leaf spot infections. Decreases in foliage diseases were ordinarily accompanied by slight increases in yield, which, however, were not great enough to pay for the materials and labor involved in the dusting. The plats dusted weekly with 20 pounds per acre of the 8-1-1 sulphur-Cuprocide-Paris green mixture which gave best control of the leaf spots did not in all cases outyield the plats in which the leaf spot diseases were not as effectively controlled. This dust gave an increase of 65 pounds of seed cotton per acre over the untreated check; 23 pounds per acre over the plats dusted with calcium arsenate; and no increase over the plats sprayed with lead arsenate. Boll weevil infestation was very low.

Effect of acid delinting on the viability of cotton seed: Delinted cotton seed, either dust-treated or untreated, lost its viability in storage much more rapidly than did undelinted seed.

Cuprocide "54" in suspension applied as a soil treatment before planting controlled post-emergence damping-off of seedlings in soil flats.

Treating the soil with 10 per cent sulphuric acid immediately after planting cotton seed reduced the final stand in sandy soil (Susquehanna fine sand) and had no effect on the stand in clay soil (Crockett clay). Seeds planted at depths of four inches or more failed to produce seedlings.

A. L. Burkett.

Tomato Diseases

Tomato seed carriers of Fusarium wilt: More than 10,000 seeds were plated from fruits of wilt-infected tomato plants selected at Jacksonville in 1936. A very low percentage of these seeds germinated and none of them produced colonies of *Fusarium lycopersici.*

In a test to determine whether the manner of separation of the seeds from the fruit of wilt-infected tomato plants had an effect on the Fusarium wilt organism, seeds were removed from the fruit pulp by fermentation and by washing under tap water. These were plated by the usual method and of a total of 1388 seeds plated no colonies of Fusarium were produced and only 17 per cent of the seeds germinated.

G. E. Altstatt.

Viability of Fusarium lycopersici in the dead dry host: Cultures from portions of wilt-infected plants collected during 1933, 1935, and 1936, stored in the open shed, indicated that the organism was still viable in most of the plants. The percentage of cultures producing colonies was quite variable between individual plants, ranging from 0 per cent to 100 per cent.

G. E. Altstatt.

Studies of the population of Fusaria in wilt-infected soil: In order to determine whether there was a relationship between the incidence of wilt in tomato plants and the population of this organism in the soil, soil samples were taken from several locations in Texas. The results obtained by plating soil dilutions at 1 to 1,000 and 1 to 10,000 in potato-dextrose agar indicated that there was no direct relationship.

G. E. Altstatt.

Varietal tests for wilt resistance: In the spring season, 9244 tomato plants of 44 varieties including 17 selections were tested in 3 fields during an epiphytotic of wilt caused by *Fusarium lycopersici.* The experiments gave evidence that like-named tomato varieties may differ physiologically when their seed is produced by different growers. For example, Marvana (Porte) was susceptible to blossom end rot and was 80 per cent wilt resistant, while in contrast, Marvana (Haven) was resistant to blossom end rot but was only 62 per cent wilt resistant. A similar contrast was seen in the behavior of Marvelosa (Porte) versus Marvelosa (Vaughan). Likewise, part of the wilt resistance of Kanora and Columbia tomatoes was lost in the production of these varieties by commercial seed companies. Seven of the 31 most wilt-resistant selections and varieties of tomatoes were seriously damaged by blossom end rot, indicating that no relation exists between resistance and this disease.

Thirty-one varieties and selections of tomatoes had time-weighted percentages of wilt resistance of 65 to 91 per cent, which is a criterion of commercially valuable resistance to *Fusarium lycopersici* causing tomato wilt. Five selections of Marglobe tomatoes with and without X-ray treatment were 67 to 91 per cent wilt resistant. Thirteen selections of Gulf State Market tomatoes varied from 34 to 64 per cent (average near 50 per cent) wilt resistant. The Stone tomato was only 19 per cent wilt resistant and Greater Baltimore was only 35 per cent wilt resistant. Since Stone and Greater Baltimore are the main varieties of summer tomatoes here, their extreme susceptibility to Fusarium wilt helps to explain why summer and fall tomatoes are not very common in this region. The following varieties of tomatoes have seed stocks on the market, desirable commercial qualities, and wilt resistance of 84 to 65 per cent: Louisiana Pink, Louisiana Red, Blair Forcing, Marvel, Marglobe, Michigan State, Sureset Forcing, Rutgers, Kanora, Prairiana, Illinois Pride, and Long Calyx Forcing.

P. A. Young.

Isolation of Fusarium lycopersici from wilted plants from different parts of Texas: Fusarium wilt-infected tomato plants have been obtained from various tomato growing regions in the state. Tissue cultures have been made from these plants and the strains of Fusarium isolated are being held in stock culture for future comparison as to physiological and morphological characteristics.

G. E. Altstatt.

Control of Tomato Seedling Diseases

Control of damping-off by seed treatments: Pre-emergence damping-off diseases were destructive in the inoculated soils in 2 hot beds. An experiment, conducted in the 1-flue-heated and electric hot beds, gave the following results expressed in average percentages of seedlings emerged and still visible 34 days after the seed was planted: Untreated seed, 18 and 35; sulphur treated seed, 21 and 22; seed treated with a mixture of half sulphur with half Cuprocide, 61; Ceresan treated seed, 52; and Cuprocide treated seed, 70 and 70. Thus Cuprocide and Ceresan (2%) greatly decreased the pre-emergence damping-off of the tomato seedlings.

Seed treatment with Cuprocide, Metrox, DuBay 1155FF, Vasco 4, and zinc oxide separately gave very beneficial control of damping-off diseases of tomato seedlings grown in the laboratory under conditions very favorable to the damping-off disease. Metrox (purple copper oxide) was nearly as effective as Cuprocide (red copper oxide) in controlling damping-off diseases. Soil treatment with Cuprocide, Ceresan, and Semesan (especially with Semesan) separately decreased post-emergence damping-off of tomato seedlings. Cuprocide and Metrox adhered to the tomato seeds much better than did the other dust chemicals tested.

P. A. Young.

Control of post-emergence damping-off: Sunshine controlled most of the post-emergence damping-off diseases of tomato seedlings. Brightness of light was measured to determine its effect in controlling the post-emergence damping-off diseases of tomatoes. Tomato seedlings that occasionally received direct sunlight of at least 1,000 ft.-candle brightness and also received nearly 200 ft.-candles of light in much of the other daylight grew well enough to become very resistant to damping-off parasites. When tomato seedlings received daylight of only 32 to 100 ft.-candles brightness, they usually all died soon of post-emergence damping-off.

In this connection, the light entering a covered hot bed and cold frame was measured. Outside daylight then was 650 to 1,000 foot-candles brightness. It was dark under a sheet bearing a layer of pine needles. The light was only 25 to 40 foot-candles under a double sheet, and was only 65 to 160 foot-candles brightness under a single sheet. Thus, only 1/4 to 1/40 of the light passed through the tomato sheets, which explains the spindliness and yellowing of tomato seedlings grown in hot beds and cold frames that are covered too much of the time.

P. A. Young.

The cost of operation of an electrically heated hot bed and cold frame: An electrically heated hot bed was constructed and operated in comparison with a flue-heated hot bed. Accurate records showed that the electric hot bed used electricity (at 2c per kwh) worth $8.44 in the evperimental test. It could have been operated practically with electricity worth $5.00. The electric hot bed gave nearly certain protection against frost, and the warm soil accelerated seedling growth almost without cost for labor. Whenever labor and fuel cost money, it is profitable to heat hot bed soil with electricity.

Half of a cold frame was heated by electric cable laid on the surface of the soil. The cable made the nearby soil 9°F. warmer than the soil in the unheated part of this frame where the soil was too cold for the optimum growth of tomato plants. The tomato plants grew better and faster in the heated half of the frame. Electricity worth $8.82 was used in this experiment. Electric heating would cost only one or two dollars for protecting this frame from frost hazard.

P. A. Young.

Wind injury of tomato seedlings: A tomato frame at the laboratory was unintentionally left covered with straw during two days after which the tomato plants in it were exposed to sunshine and wind. Many of the plants of the following varieties were seriously injured by the sun and wind: Marvana, Prairiana, Illinois Pride, Early Baltimore, Kanora, Marvelosa, Nystate, and Michigan State. The thousands of Marglobe tomato plants were not injured. The other varieties of tomatoes showed little or no injury from the sun and wind. This is a useful physiological separation of the tomato varieties on the basis of their hardiness to sunshine and wind.

P. A. Young.

A method of disinfecting and preserving hot bed frames: Creosote was found to be safe for use in disinfecting and preserving lumber in hot beds in preliminary tests. A rough lumber box was painted twice with creosote, dried for two weeks, and used for growing two crops of tomato seedlings within one inch of the black boards. The tomato seedlings grew normanally and well and were not injured by the creosote.

P. A. Young.

Control of Root Rot Nematode

Chemical control experiments: Experiments to control the soil-inhabiting nematode, *Heterodera marioni*, which causes the root knot disease of vegetables gave the following results. Injecting chloropicrin into the soil at the rates of 300, 350, and 400 pounds per acre and covering the soil with glue-coated paper during the next three days, killed 93 to 100 per cent of the nematodes as tested by growing watermelon roots in the soil. At the rate of 250 pounds of chloropicrin per acre, 88 to 100 per cent of the nematodes were controlled. At the rate of 200 pounds of the chloropicrin per acre, 86 to 89 per cent of the nematodes were controlled. The rate of 100 pounds of chloropicrin per acre controlled only 48 per cent of the soil nematodes.

Soil treated with chloropicrin at the rate of 350 pounds per acre and then wet with water showed only 78 per cent of the test watermelon plants without root knots. Thus, the glue-coated paper evidently was more effective than the water in confining the cholropicrin gas.

Carbon bisulphide injected into the soil at the rates of 1,000, 1,500, and 2,000 pounds per acre controlled 92 to 100 per cent of the root-knot nematodes in the soil plats tested with watermelon roots. Similar results were secured in the plats covered with glue-coated paper and those wet with water after treatment. The rate of 500 pounds of carbon bisulphide per acre was ineffective in controlling the root knot nematodes. Barriers of wood, paper with sorghum, and air furrows were helpful in avoiding recontamination of treated soil with nematodes. In the check plats of untreated soil, usually 50 to 100 per cent of the watermelon roots showed nematode root knots, and 43 to 100 per cent of the tomato plants showed symptoms of Fusarium wilt.

P. A. Young.

Root knot nematode control: See report Substation No. 15.

Control of Soil-borne Fungous Pathogens by Chemicals

Chloropicrin controlled 90 to 100 per cent of the *Fusarium lycopersici* in the soil as tested by the appearance of wilt in Greater Baltimore tomatoes in the plats covered with glue-coated paper. In the plats watered after treatment, the chloropicrin controlled only 81 to 94 per cent of the Fusarium wilt of tomatoes. Carbon bisulphide was ineffective in controlling *Fusarium lycopersici* in the soil.

P. A. Young.

Attempts at soil disinfection with sulphuric acid: This item is reported under Substation No. 11.

Control of Weeds with Chemicals

Control of Johnson grass and weeds: At the rates of 200, 300, and 400 pounds per acre, chloropicrin killed nearly all of the Johnson grass roots and most of the weed seeds in the soil. Carbon bisulphide killed most of the Johnson grass roots but was ineffective in killing the weed seeds in the soil.

P. A. Young.

Control of nut-grass with chloropicrin: This work is reported under Substation No. 15.

Effect of Various Sprays for Controlling Foliage Diseases on Tomato Plants

Since leaf diseases of tomatoes were practically absent this year, all nine of the spray formulae decreased the yields of the tomatoes. Spray chemicals are regarded as medicines in which the toxic effects of the chemicals on the plants predominate when there are practically no diseases to be controlled. Bordeaux mixture with sulphur decreased tomato yields 37 to 47 per cent. The spray formulae containing Cuprocide decreased the tomato yields 6 to 38 per cent. However, the Cuprocide-cotton seed oil spray is physically desirable and merits further tests. Cupro K, Z-O, Basi-Cop, Copper Hydro 40, and Coposil decreased tomato yields only 10 to 18 per cent, so probably they will be found to be valuable sprays when leaf and fruit diseases are abundant. Forty-one combinations of sprays, and also dusts, were tested extensively on spring and summer tomatoes, and were found to be tolerated without pathological symptoms of injury in the tomato leaves.

P. A. Young.

Viability of Sclerotia of Sclerotium Rolfsii

The study reported in 1936 in which *Sclerotium rolfsii* inoculated in soil in lamp chimneys were buried at College Station at depths of ten and sixteen inches has been continued. Sclerotia removed from the chimneys during 1937 were found to be dead. Those maintained in the moist soil were entirely decomposed, while the cultures maintained in the dry soil contained visible sclerotia, although none of them were found viable. Cultures maintained in the laboratory as checks contained withered sclerotia only a few of which were found to be viable.

G. E. Altstatt.

Virus diseases of tomato in Southwest Texas: Spotted wilt, a virus first reported affecting tomatoes grown in Southwest Texas in 1935, has become more prevalent. A recent survey has shown as high as 22 per cent infection in some fields, although generally the per cent of plants affected varies from one to eight per cent. Other virus diseases prevalent in the fall crop grown in this region are curly top, mosaic, yellow-bordered mosaic, fern leaf, and yellow top.

P. A. Young, G. E. Altstatt, A. L. Harrison.

Methods and Formulae Developed for Calculating Experimental Results

For the research problem this year, the following mathematical methods and formulae were developed for calculating experiments and data: (1) Formulae were derived for converting figures of pounds of chloropicrin and carbon bisulphide per acre into figures of cubic centimeters of these diluted chemicals per hole in the soil of experimental plats of different shapes and sizes. (2) A method was developed for calculating the time-weighted percentages of wilt resistance of tomato varieties to give an economic evaluation of the wilt resistance of the varieties. (3) Formulae were derived for calculating the yields of tomatoes and cotton in the experiments described.

P. A. Young.

Rose Diseases

Overwintering of fungi associated with die-back: During the spring and summer of 1937 pieces of rose peduncles showing die-back symptoms were cultured on agar. These peduncles had been collected from the variety Mrs. E. P. Thom in September, 1934, and from Luxembourg in December, 1935. All material was stored in an open shed from the time of collection until the pure culture work was done. The percentage of Diplodia recovered in February, 1937, from peduncles stored since September, 1934, was very low. Diplodia was completely absent in later tests. Similar culture work carried on from February until July, 1937, with the Luxembourg peduncles that had been stored since December, 1935, yielded a higher percentage of Diplodia.

Diplodia was also recovered in great abundance from cultures from canes of Luxembourg rose which had been infected during the 1936 growing season and had been allowed to remain on the bushes over the winter. This demonstrates the necessity of pruning during the dormant season to remove all diseased canes which may serve as sources of infection for the new growth.

G. T. Boyd.

Life history studies on die-back: By tagging and bagging buds at weekly intervals during the spring and summer, an attempt was made to gain information on the seasonal infection and spread of the disease and to learn whether or not infection occurs only through open flowers. Fifteen buds of Luxembourg roses were selected each week and vegetable parchment bags were placed over the buds on alternate weeks. The dates of peduncle infection, main stem infection, and normal shed of the buds were recorded. From the data obtained it may be concluded that practically no reduction in die-back resulted when the flowers were bagged from before the time of opening until thirty days after opening. When the bags were removed the peduncles in many cases were found to be blackened, but no fungous fruiting bodies were observed. Since such bodies are ordinarily present in such peduncles and canes in rose fields, their absence on peduncles of bagged flowers may possibly indicate that the initial stages of die-back represent a physiological breakdown of the tissues and that the fungi usually observed are secondary invaders. It seems likely that the vigor of the plant, as expressed by the amount of growth and the retention of foliage, determines to a great extent the degree of die-back. The disease may be in many cases physiological in origin, followed by fungi which are active in the downward spread of the disease.

G. T. Boyd.

Die-back inoculations: Canes and flowers of Etoile de Hollande were inoculated with several fungi obtained from die-back material. All of the flower and the majority of cane inoculations were unsuccessful. Several fungi were able to produce slight symptoms of infection, but few were able to spread into areas beyond the point of inoculation. Apparently die-back cannot be caused in Etoile de Hollande by the fungi ordinarily associated with the disease in other varieties. Similar tests which had been planned for Luxembourg, a susceptible variety, did not materialize, because the available plants did not thrive in the experimental plats.

G. T. Boyd.

Field control of die-back: Field tests on the control of die-back by means of pruning, spraying, and dusting were carried out at Substation No. 2. Satisfactory control of die-back was obtained by pruning off the flower buds before they opened. The application of sprays or dusts was not necessary to obtain control, but appeared to reduce infection somewhat when plants were unpruned.

Similar tests were conducted at College Station, but the absence of die-back in both treated and untreated bushes rendered it impossible to obtain data on control.

G. T. Boyd.

Field control of black spot: In connection with the pruning, spraying, and dusting experiments outlined above for the control of die-back of Luxembourg rose, records were obtained relative to the effects of these treatments on the incidence of black spot. A dust containing 300-mesh sulphur and Cuprocide, and a spray composed of Bordeaux, wettable sulphur, and Kayso were most effective, both giving approximately 92 per cent control of black spot. Disbudding (removal of flower buds before opening) during the growing season did not affect the percentage of black spot; it did, however, improve the amount of foliage and general appearance of the plants. The best results were obtained where disbudding was practiced in conjunction with the application of fungicides.

G. T. Boyd, E. W. Lyle.

Effects of fungicides on germination of spores of the black spot fungus (Diplocarpon rosae): The ability of the fungous spores to germinate in the presence of the various fungicides tested in the field was determined by laboratory tests of spore suspensions placed on clean microscope slides and treated with the various sprays and dusts. Copper Hydro 40, Basi-Cop, and Bordeaux mixture all inhibited germination to a satisfactory extent. A combination of wettable sulphur and Cuprocide likewise inhibits spore germination, although neither substance used alone has any appreciable effect.

G. T. Boyd.

Viability of black spot spores: Black-spot-infected rose leaves collected every two weeks from a climbing Blaze at College Station from January to May, inclusive, were kept under dry laboratory conditions and germination tests were made of the fungous spores every two weeks until the spores were no longer viable. It was found that the per cent of germination decreased with each test, but some of the leaves produced viable spores for six weeks, the green leaves yielding a larger per cent of viable spores than the yellow leaves. Germination tests were also made with the spores of shed leaves which were allowed to remain on the ground for one month. All spores were plasmolyzed and no germination was recorded.

J. J. Taubenhaus.

Studies on spreader materials: The use of various amendments in sprays to increase the adherence and spread of fungicidal materials is a standard practice. A study of the effect of several commercial spreaders on the spread, adherence, and toxicity of a number of copper compounds was planned. To date these studies have been completed for Cuprocide. The effect of spreaders on the adherence of Cuprocide sprays was determined by the sodium diethyl dithiocarbamate method of colorimetric analysis of the amount of copper removed from sprayed slides after a standardized procedure of washing in water. The residue after washing was removed from the slides with hydrochloric acid and analyzed by the same method for copper content. The results of these determinations show that the greatest adherence of Cuprocide is obtained by the use of Lethane Spreader, a commercial spreader. Other compounds of value are dry Areskap, Aresklene, SS-3, wettable sulphur, and Corikal N powder. Igepon T powder, Kayso, dry Aresket, and Dry Ortho spreader were slightly better than no spreader. The effect on copper adherence of varying the concentration of Cuprocide was tested. Although the results were rather inconsistent, a trend was indicated toward greater adherence as the amount of Cuprocide is increased up to three pounds in fifty gallons. Further increases tend to decrease the percentage of copper adhering to the slides. The effect of varying the amount of dry Aresket, a commercial spreader, on the adherence of Cuprocide was determined. The results indicate a rather definite trend toward greater adherence with each increase in the amount of spreader.

The effect of various spreaders on the distribution of various copper sprays upon foliage was determined by the leaf-print method. The coppers used and rates per 50 gallons of water are as follows: Cuprocide, 0.5 lb.; Coposil, 1.0 lb.; Copper "KB," 1.0 lb.; Copper Hydro 40, 3.0 lb.; Basi-Cop, 1.0 lb.; Bordeaux 3-3-50, 6.0 lb. The spreaders used and the amount of each in 50 gallons of spray are as follows: dry Aresket, 0.25 lb.; Aresket 240, 0.5 pt.; dry Areskap, 0.25 lb.; Areskap 50, 0.5 lb.; Kayso, 1.0 lb.; Aresklene, 0.25 lb.; Dry Ortho spreader, 1.0 lb.; Lethane spreader, 1.0 qt.; wettable sulphur, 3.0 lb.; SS-3, 0.5 pt.; Corikal 3B, 0.25 lb.; Corikal N. P, 0.25 lb.; Igepon T P, 0.25 lb.; Igepon Ap. Ex. Conc., 0.25 lb.; Santomerse, 0.5 pt.; no spreader. The sprays were applied to foliage of Etoile de Hollande roses. The prints obtained from this work are filed in the Division office. With few exceptions it was found that the effect of a given spreader on the distribution of copper sprays varied little with the different copper compounds. It was also found that spreaders superior in adherence were not necessarily superior in distribution.

The effect of spreaders on the toxicity of Cuprocide sprays to spores of the black spot fungus was determined by means of spore germination tests. The results obtained may be considered tentative because the advent of hot weather prevented the duplication of the tests. Spreader SS-3 increased the toxicity of Cuprocide to a marked extent. Other spreaders that increased the toxicity of Cuprocide were Lethane spreader, wettable sulphur, Aresket 240, and Aresklene. Kayso and Dry Ortho definitely reduced the toxicity of the copper.

G. T. Boyd.

The effect of weathering on the toxicity of copper sprays to spores of Actinonema rosae: This was determined by spraying a series of clean microscope slides with the different sprays, exposing them to outside weather conditions, and testing at bi-weekly intervals the percentage of spores germinating in droplets of spore suspension placed upon the sprayed slides. The total rainfall for the period of the experiment was 3.56 inches. With certain exceptions the toxicity of the sprays used gradually decreases with an increase in time of exposure. No definite trend resulted from the use of dry Aresket.

G. T. Boyd.

Leaf-streak disease: The new foliage disease observed on Angelus roses in a commercial nursery near Tyler in the fall of 1936 was subjected to further observations during 1937. All of the transplanted budded cuttings failed to survive. The two-year-old field grown plants showing symptoms of the disease which were set out near Tyler also died. Those set out at College Station lived long enough to show slight symptoms and then died. Of the budded cuttings potted and placed in the greenhouse, only one normal and one diseased survived. The young plant arising from the diseased bud showed clear symptoms of the disease and then died. Although the results thus far are too meager to serve as a basis of conclusions as to the cause of the disease, the indications are that the trouble is virus in nature and that the disease is "streak," as it is known in California.

G. T. Boyd, E. W. Lyle.

Preparations for histological work on rose diseases: Excellent material of a number of infections in various stages was collected and fixed during the fall of 1937. This material includes die-back on Columbia rose, streak on Edel, red blister-canker on Caledonia and Radiance, crinkle mosaic on E. G. Hill, black spot on several varieties, and *Gloeosporium* black canker on Luxembourg. Most of these specimens were collected during October at Substation No. 2 at Lindale, and in commercial nurseries. The material will be sectioned, stained, and examined.

G. M. Watkins.

An unidentified cane disease: A hyperplastic and necrotic type of disease was observed in September on canes of Caledonia rose, and subsequently on Radiance and Mrs. E. P. Thom. The disease is characterized by roughened hydrotic swellings in purplish-black areas on the canes. The distribution of the disease includes the vicinities of Myrtle Springs, Tyler, and Winnsboro. Cultures of diseased materials yielded two species of bacteria and a fungus, none of which has proved in inoculation experiments to be pathogenic. The possibility of bud transmission is being studied.

E. W. Lyle, G. M. Watkins.

Gloeosporium black canker: A conspicuous black cane canker was observed causing considerable damage in a planting of Luxembourg roses at Substation No. 2. Young lesions usually appear to be centered around thorns; in each case as the lesion spreads the epidermis and cortex of the cane is blackened and finally completely girdled. Cross sections through advanced lesions show the pith to be dark-brown in color. In advanced stages of the disease the surfaces of lesions are covered with numerous acervuli from which escape the salmon-colored masses of *Gloeosporium* conidia. A species of *Gloeosporium* has been isolated repeatedly from lesions in various stages of development, but several attempts to cause the disease by inoculation with these spores have failed.

E. W. Lyle, G. M. Watkins.

Garlic Diseases

Prevalence during the 1936-1937 season: Frequent surveys indicated that garlic bulb rots were not as extensive during the 1937 season as in former years, primarily because less rainfall during the growing season and the harvest period. During the winter months there were numerous rains but none was heavy enough to cause run-off. At the harvest there were but few showers, which made the natural curing of garlic much easier.

Stands were poor in most cases because of the lack of healthy bulbs for seed (cloves). The previous crop was exceptionally poor, and the garlic available for seed was infected with bacterial and fungal organisms.

During the early season, the following organisms were commonly found on the young plants showing symptoms of disease: *Sclerotium rolfsii*, *Fusarium* sp., *Helminthosporium* sp., *Aspergillus* spp., a fungus which appears to be of the genus Diplodia and a bacterium of the soft-rot group. About 1 per cent of the young plants were infected by these organisms.

J. J. Taubenhaus, G. E. Altstatt.

The effect of "mosaic" on garlic: During 1936 and 1937, a condition of the leaves was observed which appeared to be a mosaic or striping between the veins, causing affected plants to appear a yellow-green color instead of the normal dark green color. Fifty plants showing this condition were labeled on February 18, and examined on June 10, 1937, to determine what effect this condition had on the general health of the plant at maturity. It was found that 78 per cent of the plants produced sound bulbs, 6 per cent showed bacterial and fungous infection, and the remaining 16 per cent had been completely destroyed by disease.

G. E. Altstatt.

The effect of weevil infestation: The garlic weevil, *Ceutorhyncus tau*, was not as prevalent during the past season as in 1936. This organism eats the center leaves of the young plants, often injuring the plants severely, causing stunting and opening the way for infection by bacteria and fungi.

About 50 plants showing weevil injury in February were labeled and examined at harvest. It was found that only 52 per cent of these plants had produced sound bulbs, 19 per cent were weakened and stunted, and the remainder badly diseased, a great many having rotted away completely.

G. E. Altstatt.

Effect of bacterial and fungal rots on the seed pieces (cloves), and the control of these organisms: The selection of 100 per cent disease-free bulbs was impossible from the 1936 crop. It was found that the disease reduced the vitality of the plant greatly, and that bulbs produced from selected nearly-disease-free cloves were better and heavier than bulbs grown from cloves selected as field-run.

Chemical treatments of the cloves before planting showed that mercuric chloride 1-1,000 used as an instantaneous dip was the most effective agent for reducing the numbers of diseased bulbs. Cloves rolled in sulphur before planting produced a high percentage of sound bulbs.

G. E. Altstatt.

Artificial curing of garlic: The garlic raised in the experimental plats was cured artificially in an experimental drier at Moulton. Details of these experiments are given in the report of the Division of Agricultural Engineering.

Variety studies: Twenty-five varieties of garlic were grown under Texas conditions during the year in an attempt to find a disease-resistant strain. All of them were subject to the diseases, but a few had the desirable qualities of earliness, thin scales, and medium size bulb. The better varieties will be grown again for observation.

G. E. Altstatt, J. J. Taubenhaus.

Rice Diseases

Organisms associated with the discoloration of rice kernels: A number of organisms associated with the discoloration of rice kernels were reported in 1935 and 1936. Results obtained from the plating on nutrient agar of more than 25,000 kernels in the several stages of discoloration during 1937 confirm previous work. It was found also that kernels showing no apparent discoloration, when cultured, produced colonies of the same organisms, indicating that these organisms are present in what has been considered disease-free rice.

In connection with the discoloration of rice kernels, about 2,000 kernels showing symptoms of stink-bug injury were plated. The organisms recovered were: *Helminthosporium* sp. (34%), *Trichoconis* sp. (37%), and

Fusarium sp. (3.7%). Indications are that the stink-bug may aid in the dissemination of the black kernel condition.

The viability of the kernels was not appreciably affected by the degree of discoloration due to diseases, but was considerably lowered by the stink-bug injury.

Continuance of the work on the effect of various methods of "capping" rice on the incidence of black kernel shows very minor differences in 1937.

J. J. Taubenhaus.

The use of sulphuric acid to control weeds in rice fields: Experiments with the application of 15 per cent sulphuric acid by weight at the rate of 120 gallons per acre just prior to flooding rice fields indicate that weeds other than grasses can be controlled.

It has been demonstrated that the application of acid to fields flooded with water merely kills the weeds to the water-level. They survive and come out again in a few days.

J. J. Taubenhaus, R. H. Wyche.

Toxicity of Fungicides

Effect of fungicidal dusts on the germination of spores of various plant pathogens: Fungicides alone or in various combinations were tested to determine their effect on the germination of spores of the following organisms: *Colletotrichum gloeosporioides, Aspergillus ochraceus, Aspergillus tamarii, Vermicularia varians, Botrytis cinerea, Sclerotium rolfsii,* (sclerotia), *Rhizopus nigricans, Aspergillus niger, Tilletia horrida, Aspergillus wentii, Pestalozzia funerea, Trichoderma koningi, Septoria apii, Helminthosporium turcicum, Cercospora* sp. and *Sphacelotheca sorghi.* Cuprocide and Paris green inhibited germination throughout the tests, while the other fungicides alone or in combinations were toxic to the spores of some organisms and less effective on others. Sulphur alone was not very toxic, but in combination with other fungicidal dusts contributed to the toxicity of the combination.

J. J. Taubenhaus.

Effect of sulphuric acid on the germination of spores of various plant pathogens: Sulphuric acid in dilutions of .1 per cent, .05 per cent, .025 per cent, .0125 per cent, .00625 per cent, .00312 per cent, and .00156 per cent, was tested on the spores of the following organisms: *Colletotrichum gloeosporioides, Aspergillus ochraceus, Aspergillus tamarii, Vermicularia varians, Botrytis cinerea, Sclerotium rolfsii, Aspergillus niger, Rhizopus nigricans, Tilletia horrida, Aspergillus wentii, Pestalozzia funerea, Trichoderma koningi, Septoria apii, Helminthosporium turcicum,* and *Cercospora* sp. All dilutions used completely inhibited germination of the spores of most of the organisms tested.

J. J. Taubenhaus.

The effect of aging on the toxicity of Cuprocide and other fungicidal dusts: Laboratory tests on slides were made at intervals of two months for one year to determine the effect of aging on the toxicity of fungicides. The spores of *Sphacelotheca sorghi*, sorghum smut, were used. Aging up to one year has had very little effect on the toxicity of the dusts. Complete inhibition was obtained with applications of Cuprocide alone or in combination throughout the experiment and all dusts and their combinations were toxic to the spores. The experiment will be continued.

J. J. Taubenhaus.

The effect of various fungicidal chemicals on the growth of damping-off organisms in pure culture: Two per cent Ceresan was found to inhibit growth of *Pythium* sp. and *Rhizoctonia* sp. in pure culture when used at rates of one to eight grams per liter of nutrient medium. Cuprocide, Copper "KB" (copper oxychloride), and zinc oxide "AAZ" were next effective in the order listed, and gave satisfactory control of the growth of the organisms when used at the higher rates. Cuprocide and Copper "KB" were much more effective on Pythium than they were on Rhizoctonia.

A. L. Burkett.

Sulphuric acid treatment for various periods of time as affecting the survival of Bacterium malvacearum and other organisms in cottonseeds: Nearly 9,000 seeds were divided into convenient groups and treated with concentrated sulphuric acid for periods of 15, 30, 45, and 60 minutes. Approximately half of the seeds of each group were given an additional two minute disinfection in 1-1,000 mercuric chloride in 50 per cent alcohol. After treatment, all seeds were cultured in Petri plates of potato-dextrose agar.

Colonies of *Bacterium malvacearum*, *Fusarium* spp., *Sordaria* (?), *Gibberella* (?), *Alternaria* or *Macrosporium*, *Diplodia*, *Sclerotium*, *Helminthosporium*, *Glomerella*, *Phoma* sp., *Melanospora* sp., *Basisporum gallarum*, *Brachysporium*, *Rhizopus*, *Aspergillus*, *Trichoderma*, and a sterile mycelium were recovered from the seeds cultured.

Fewer colonies of bacteria and fungi were recovered from seeds undergoing 60-minute treatment than those in the shorter periods of time. In some cases seeds treated with $HgCl_2$ yielded fewer colonies than those with only the acid treatment. More colonies of bacteria and fungi were recovered from floating than from sinking seed.

There was no decided difference between the number of colonies of bacteria and fungi recovered from seeds that germinated and those that failed to germinate.

More colonies of bacteria and fungi were recovered from the hulls of the seeds soaked in acid 60 minutes than from their embryos.

J. J. Taubenhaus, D. C. Bain.

Control of Damping-off of Seedlings

The effect of chemical seed and soil treatments on damping-off and other diseases: Effective control of pre-emergence damping-off of beans (bush), beets, carrots, cotton, eggplants, grain sorghum, holyhocks, peanuts, English peas, peppers, pumpkins, radishes, spinach, sugar beets, sweet peas, tomatoes, and watermelons was obtained by the use of Cuprocide (cuprous oxide) seed treatments. In the trials with cotton Cuprocide was less effective than two percent Ceresan in the control of sore-shin and damping-off. Although Ceresan caused injury to the seeds when used at rates higher than those recommended, Cuprocide did not cause injury when used at rates as high as ten ounces per bushel of seed. Injury from Ceresan treatments was found to be greater in soils which were relatively low in organic matter content, but did not seem to be affected by the pH of the soils. Experiments with grain sorghums and peanuts planted in soil flats in which damping-off was prevalent showed beneficial results from the use of copper seed treatments. Zinc oxide seed treatments also reduced pre-emergence damping-off of grain sorghums planted in flats. Cuprocide and basic copper sulphate seed treatments reduced the stands of turnips but Ceresan and copper oxychloride did not appear to cause injury.

J. J. Taubenhaus, A. L. Burkett.

The effect of various seed treatments on the viability of cotton seed and their relation to seedling diseases: The maximum safe periods for soaking cotton seed in water or concentrated sulphuric acid were 4 hours and 1/4 hour, respectively. Trials with the water or acid at various temperatures for varying intervals of time indicated that the maximum safe temperature and time for water soaking was 110-150° F. for 3 hours, and 150° F. for 15 minutes for hot acid treatment.

Of several disinfectants used on delinted and undelinted cotton seed, Ceresan (2 per cent mercury chloride) showed the greatest benefits. This compound was found to be more effective in controlling damping-off and sore-shin on delinted seeds. Cuprocide (red copper oxide) was less efficient.

Sulphuric acid delinting hastened the germination of cotton seed and permitted more uniform and thorough coverage of the seed.

J. J. Taubenhaus, K. W. Wang.

Chemical seed treatment aids fall production of bush beans: Fall-planted bush bean seeds treated with Cuprocide produced mature plants about ten days earlier than the untreated seed, and increased the yield of beans about 18 per cent. Treating the seeds with 2 per cent Ceresan did not hasten the maturity but increased the yield about 34 per cent. Cuprocide "54" soil treatments materially increased the size of the plants and increased yields slightly.

A. L. Burkett.

Seed treatment for carrot, beet, pea, and turnip seeds: Carrot and beet seed treated with Cuprocide produced better stands of seedlings than did the untreated seeds of these species. Pea (Pisum) seed treated with Cuprocide produced 17 per cent more seedlings than did the untreated pea seed. In contrast, turnip seed treated with Cuprocide produced fewer seedlings than did the untreated turnip seed.

P. A. Young.

Other Diseases

Citrus diseases:

Citrus gummosis and wood rot
Citrus chlorosis
Fruit rots
Fruit blemishes

These items are reported under Substation No. 15.

The control of strawberry chlorosis: Sulphur applied in the furrow in order to acidify the soil before planting strawberries seemed to control the chlorosis to a certain extent. pH readings at several points in the field showed that the yellowed or chlorotic plants were common in areas where the soils were definitely alkaline, but relatively infrequent in the acid soils.

J. J. Taubenhaus, J. N. Roney.

Sulphur in the control of potato scab: Certified and non-certified Irish potatoes (Bliss Triumph) seed pieces were rolled in wettable sulphur before planting. Lack of rain during the growing season reduced the yield in all plats. The application of sulphur reduced the yield somewhat, but did help to control the scab.

J. J. Taubenhaus, J. N. Roney.

Seed piece treatment at College Station with the Bliss Triumph variety (certified) with Spider brand sulphur indicated that while yields were extremely low because of dry weather, the sulphur treated seed produced a higher percentage of scab-free potatoes.

J. J. Taubenhaus, A. L. Burkett.

Stinking smut of wheat in Baylor County: A survey of wheat fields was conducted in Baylor County May 26-29, 1937, following a report of widespread stinking smut in that region. The twenty-two fields examined were distributed well over the wheat-growing zones in the county. Ten fields showed no smut, and the remaining twelve had smut ranging from 5.9 to 58.7 per cent. The worst infection centered around Bomarton. Interviews with the growers revealed that few had treated the seed wheat and almost none had used the proper fungicides and had applied the dusts correctly. Adequate control measures for stinking smut are well known and the outbreak of the disease in Baylor County in 1937 seems to be directly correlated with the use of improper seed treatments or none at all.

G. M. Watkins.

Sorghum root and crown rot: Studies on this disease in cooperation with Mr. R. E. Karper have been continued. Isolations from seedlings grown in the laboratory in infested soil yielded a fungus with profuse oogonia, each with numerous antheridia arising from hyphae distant from those bearing the oogonium.. This fungus, corresponding to *Pythium arrhenomanes* Drechler which has already been found by other workers to be the cause of a sorghum root rot, was used in inoculation experiments in the greenhouse. Inoculations in April killed sorghum seedlings of varieties resistant as well as of those susceptible to the disease in the field; later inoculations (May and June) did not produce definite symptoms on any of the plants.

W. N. Ezekiel.

Effect of foliage dusts on yield of ueanuts: Dusting Spanish peanuts with mixtures of 8 parts of sulphur, 1 part of Cuprocide, and 1 part of calcium arsenate and with 7 parts of sulphur, 1 part of Cuprocide and 2 parts of calcium arsenate increased the yield of stover 1,000 pounds and 600 pounds per acre and of nuts 1 bushel and 3 bushels per acre, respectively. No diseases were observed. Because of drought yields of nuts were very low.

J. J. Taubenhaus, A. L. Burkett.

Other diseases of economic crops:

Dill leaf and stem blight
Carrot leaf blight
Papaya leaf blight
Dutch Iris bulb rot
Aster mildew
Sweet pea mildew

These items are reported under Substation No. 15.

Plant Disease Survey

This Division renders, in cooperation with the United States Plant Disease Survey, an annual report of the kinds of plant diseases in the state and the extent to which the crops affected are damaged. All pathologists in the Division have been appointed collaborators in the survey and have contributed information on the diseases prevalent during 1937.

Diseases not Previously Reported in Texas*

Astragalus mollissimus, crown rot, *Fusarium* sp.
Brassica rapa, extreme crinkle mosaic, virus.
Callistephus chinensis, downy mildew, *Basidiophora entospora.*
Capsicum frutescens L., yellow tobacco mosaic, virus.
Carica papaya, root and stem rot, *Fusarium* sp.
Celtis mississippiensis, leaf spot, *Septoria* sp.
Citrullus vulgaris, albinism, genetic.
Citrullus vulgaris, crinkle mosaic, virus.

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*Identification of pathogens in certain cases was made by members of the Division of Mycology and Disease Survey, U. S. Department of Agriculture.

Citrullus vulgaris Schr., *Macrosporium cucumerinum* Ell. & Ev.
Citrus sp., sooty blotch, *Gloeodes pomigena.*
Dianthus caryophyllus, stem blight, *Vermicularia herbarum.*
Dianthus sp., anthracnose, *Vermicularia* sp.
Eschscholtzia californica, collar rot, *Alternaria* sp.
Eustoma russellianum, stem blight ?, *Alternaria* sp.
Ficus carica, *Capnodium* sp.
Fraxinus sp., rust, *Puccinia peridermiospora.*
Gossypium hirsutum, interveinal yellowing and brown leaf spot, potash deficiency.
Gossypium hirsutum, leaf scald.
Gossypium hirsutum, moldy leaf spot, *Cercospora gossypina* Cke.
Helianthus argophyllus, downy mildew, *Plasmopara halstedii* (Farl.) Berl & DeToni.
Helianthus argophyllus, leaf spot, *Septoria helianthi* Ell. & Kellerm.
Ilex opaca, leaf spot, *Phyllosticta opaca* E. & E.
Ilex vomitoria, leaf spot, *Rhytisma ilicincola* S.
Ipomoea trifida, white rust, *Albugo ipomoeae-panduranae* (Schw.) Sw.
Juniperus virginiana, rust, *Gymnosporangium claviceps* C. & P.
Lagerstroemia indica, sooty mold, *Fumago vagans* Pers.
Lagerstroemia indica, powdery mildew, undet.
Linum sp., boll disease, *Alternaria* sp.
Lolium multiflorum, rust, *Puccinia coronata* Cda.
Lycopersicum esculentum, fruit rot (sour rot), *Oospora lactis parasitica* F. J. Pritchard and W. S. Porte.
Lycopersicum esculentum, milky leaf.
Lycopersicum esculentum, yellow tobacco mosaic, virus.
Lycopersicum esculentum, crinkle mosaic, virus.
Lycopersicum esculentum, leaf roll.
Lycopersicum esculentum, leaf curling mosaic, virus.
Lycopersicum esculentum, sack rot, *Bacillus carotovorus* L. R. Jones ?
Lycopersicum esculentum, *Helminthosporium* sp.
Nicotiana tabacum, mosaic, virus.
Oxalis sp., rust, *Aecidium oxalidis* Thm.
Phaseolus vulgaris, mosaic, virus.
Phaseolus vulgaris, powdery mildew, *Erysiphe polygoni* DC.
Phaseolus vulgaris, halo blight, *Phytomonas medicaginis phaseolicola.*
Physalis hederaefolia, crinkle mosaic, virus.
Pinus palustris Mill., *Peridermium carneum* S. & E.
Prunus domestica, leaf spot, *Cercospora circumscissa* Sacc.
Quercus marilandica, *Hypoderma ilicinum* de N.
Rosa sp., streak, virus.
Rosa sp., crinkle, virus.
Rosa sp., canker, *Gloeosporium* sp.
Rubus sp., interveinal mild mosaic, virus.
Rubus sp., double blossom, *Fusisporium rubi* Wint.
Rubus sp., die-back, *Coniothyrium* sp.

Smilax bona-nox, leaf spot, *Cercospora smilacis* DeT.
Solanum melongena, seedling wilt, *Angullulina pratensis.*
Solanum tuberosum, spindle tuber, virus.
Solanum tuberosum, "haywire," virus.
Symphoricarpos sp., powdery mildew, *Microsphaera diffusa* Cke. & Pk.
Trifolium amphianthum, rust, *Uromyces minor* Schrt.
Tripsacum dactyloides, rust, *Puccinia polysora* Underw.
Vaccinium arboreum, *Ophiodothella vaccinii* Boyd.
Vigna sinensis, ashy stem blight, *Macrophomina phaseoli.*
Viola sp., *Colletotrichum violae-rotundifoliae* (Sacc.) Davis.
Zea mays, black bundle disease, *Cephalosporium acremonium* Cords.

SOIL SURVEY

(In cooperation with the Bureau of Chemistry and Soils,
U. S. Department of Agriculture)

During the last year soil survey work was carried on continuously in two counties and over one-half year in another. Field parties consisted of about equal numbers of State and Federal men. The surveys were confined to Fannin, Dimmit, and Brown Counties, and a total of 722,560 acres was covered in the detailed surveys of these counties.

Increasing requirements for information to be furnished various agencies concerned with the studies of land use problems have caused more exacting soil studies and refinements of classification in the field, making more detailed examinations necessary of the soil units shown on the maps. Some larger scale maps are now being constructed on a scale of two inches to the mile, but as yet most of the work is still done on maps of a scale of one inch to the mile. More and more time is being given by the field men to soil studies relating to land use, the relationships of the various soils to their suitability for crops, and the characteristics which enable their protection and improvement under use. A closer study is being made to secure crop yield data that will aid in the development of a universal system of land and soil ratings.

Inspections of the various areas being surveyed were made occasionally to secure uniform soil classification and to aid in the accurate delineation of the soil units on the maps. The national basis of soil classification and nomenclature is used throughout the State, so that the studies will be uniform in all parts of the various soil zones of the United States represented in Texas. All except two of the soil zones of the United States are represented in Texas, although local variations in environment and in influences of soil development have caused the development of many soils in the State that are not found elsewhere. The broader soil relationships of the State, as well as the importance of local soil areas developed under the Texas environment, have been shown in the recently issued publication of the United States Department of Agriculture entitled "Atlas of American Agriculture."

Soil Survey of Fannin County

The soil survey of Fannin County has continued throughout the year. This is an important agricultural area, and a very large proportion of the land is devoted to farm crops. Although a large proportion of the land consists of dark soils, largely of heavy texture, a considerable amount is of sandy timbered soils of low productiveness. The soil map is being made on a scale of two inches to the mile, which allows an inclusion of great detail and also enables the designation of slope classification by particular symbols where the slopes differ from the standards set for the normal soil type or soil type phase. In carrying on this work the map data of some of the completed areas were furnished the Resettlement Administration workers to aid in studies and practices connected with local resettlement projects.

The soil survey of the county has covered some parts of most sections, and probably all soils and phases have been identified. These amount to nearly a hundred mapped units of soils, soil phases, and phases of surface relief.

E. H. Templin, J. W. Huckabee, Jr., I. C. Mowery,
M. H. Layton, W. T. Carter.

Soil Survey of Dimmit County

Field work has progressed continuously in Dimmit County throughout the year, a field party of two men having devoted all of their time to this area. The county is within one of the important truck crop producing areas of the Winter Garden District of southwest Texas, where the production of winter vegetables for the northern markets has become an important industry. Irrigation is necessary, and a good supply of suitable water from both stream and well sources permits the production of crops without having to depend on the rainfall, which is uncertain. Thus far a considerable number of soils have been identified, studied, and mapped that are well suited to various truck and farm crops, fruits, and berries. Much of the land remains in ranches and is used only for grazing. Doubtless, with the growth and spread of the vegetable and fruit growing industries the soil survey will be useful in indicating the location and extent of soils suitable for the agricultural enterprises that may be undertaken.

The subexperiment station at Winter Haven in this county is carrying on research in various matters relating to crops and soils and gradually developing much information for the agricultural interests. This general information and much of particular relation to soils and crops can be made applicable to the soils in various sections of the Winter Garden District through the medium of the soil maps and the accompanying soil survey reports.

H. M. Smith, J. W. Huckabee, Jr., W. T. Carter.

Soil Survey of Brown County

On account of an insufficient field force, only a small amount of work could be done in this county during the year. This important county, in which an irrigation district has been established, lies in a transitional section where two important soil zones merge and many local outcrops of varied formations occur. This has given a complex arrangement of soils which requires very careful attention to detail in classification and separation of soil units. It is hoped to provide soon a larger force to complete the survey of this county as soon as possible.

W. I. Watkins, T. W. Glassey, W. T. Carter.

Miscellaneous

During the year the Division of Soil Survey cooperated with several other divisions in giving information relating to soils in the various parts of the State. This included field trips to study the soils of the West Cross Timbers area in order to secure information for the Director.

Some field inspection work was done in cooperation with the Soil Conservation Service in various areas in the State.

Inspections of soil survey areas in progress of survey were made as regular duties of the Chief of the Division of Soil Survey acting as Inspector of District 4 of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture.

Considerable work was done in revising and correcting soil survey reports for publication. Papers relating to Texas soils were prepared and presented at meetings. There was considerable correspondence with landowners and others relating to soils and soil problems.

A large amount of work was done in constructing a generalized soil map and preparing much soil data for Texas and District 4 of the Bureau of Chemistry and Soils to be used in the Yearbook of the United States Department of Agriculture for 1938.

W. T. Carter.

FARM AND RANCH ECONOMICS

Organization and Management of Farms in the High Plains Cotton Area of Texas

(In cooperation with the Bureau of Agricultural Economics,
U. S. Department of Agriculture)

Details of the organization and operation of 127 to 141 farms have been ecorded during the five-year period 1931 to 1935. During 1936, farm business records only were obtained on 70 of these same farms. Through cooperation with the Soil Conservation Service, maps showing soil types, lopes, erosion condition, and vegetative cover or crops grown in 1936 were prepared for each of the farms for which records were obtained in 1935 A special survey of soil conservation practices was also made on these sam farms. All of these data have been tabulated and analyzed and are bein prepared for publication.

During the six years in which records have been obtained, the averag size of these farms has been 275 acres, of which 231 acres were in crops Average returns to labor and management, after allowing 6 per cent return on all farm capital, varies from $124.00, in 1932, to $1,808.00, in 1933 as compared to the six-year average return of $850.00. During thes same years yields of cotton varied from an average of 39 pounds per acre in 1934, to 245 pounds, in 1932, and an average for six years of 182 pounds

In the last two reports, attention was called to the rapid rate at whic tractor power is replacing workstock and to the increase in the size o both power and equipment units. The extent of these changes is briefl indicated in the following table.

	1931	1937
Per cent of farms using tractors	25.5	78.6
Average number of workstock per farm	6.2	2.7
Per cent of farms using only two-row or larger equipment	52.5	86.5
Per cent of farms using four-row equipment	.0	11.1

The significance of these changes in the use of power and equipmen from the standpoint of their possible effect on the number and size of farm is brought out in the following table.

	Horse-drawn		Tractor-drawn	
	1-row	2-row	2-row	4-row
Per cent of all farms using this type of equipment in 1937	3	18	68	11
Average acreage crops on farms using one set of equipment	98	182	233	408
Estimated capacity in—				
Total crop acres	100	180	250	450
Acres cotton	56	105	193	350
Estimated number of farms required for the operation of the 1934 crop acreage in five counties studied	15,260	8,480	6,100	3,346
Per cent of actual number of farms in 1934	146	81	58	33

The figures in the last two lines in this table are based on the assump tion or possibility of all farms being operated with one set of each of th four sizes of power units and accompanying equipment, and that suc equipment would be used to the estimated capacity. Thus it will be see that if all farms used but one set of one-row equipment the number o farms required to operate the total amount of crop land in the five countie from which records were obtained would be increased 46 per cent. Similarl the use of two-row horse-drawn, two-row tractor-drawn, and four-row trac or-drawn equipment would result in the number of farms being reduced to 1 per cent, 58 per cent, and 33 per cent, respectively, of the actual number of farms in 1934. All present indications are that these changes in the use of power and equipment will continue until a level of operating efficiency approximating at least that of two-row tractor-drawn equipment has been reached.

C. A. Bonnen, B. H. Thibodeaux, Bur. Agr. Econ.,
and A. C. Magee.

Regional Agricultural Adjustment

(In cooperation with the Bureau of Agricultural Economics and the Agricultural Adjustment Administration, U. S. Department of Agriculture)

This project has for its purpose the development of information, by type-f-farming areas, to facilitate the planning of adjustments in the agriculture f each area. The work has been divided into two phases:

1. The descriptive phase, in which the State is divided into areas within which there is a high degree of similarity in soils and other physical feaures, as well as in the character of the agriculture and its related physical nd economic problems. Bulletin No. 544, "A Description of the Agriculture nd Type-of-Farming Areas in Texas," was published during the year. Thirty-seven major areas and sub-areas are identified, and descriptive material relating to the natural and economic factors contributing to the griculture of each area is presented in this publication.

As a further refinement of the descriptive phase, the leaders of this proect are assisting the Extension Service in the work of county agriculural program planning. In this work each county is divided into areas by he county planning committees, in somewhat the same manner as the State was divided into major type-of-farming areas. Each of these areas is hen described as to its soils, topography, native vegetation, and present and use. The physical problems of production are considered and recommendations as to land use are made. It is felt that the county planning work will provide an excellent basis for orienting research and extension rograms and will permit a more intelligent administration of all programs imed at the adjustment of agriculture.

2. The analytical phase, in which exitsing types of farming are exlained in terms of the underlying causes, and in which detailed information ertaining to the production and production requirements of all of the alernative uses of land is being developed. Such information will permit a areful appraisal of the alternative uses of land and of any changes in land se which may be suggested from time to time in both action and educaonal programs.

Work under this phase of the project is being carried on in three areas, amely, the Elm Creek watershed in the Black Prairie Area, the Low Rolling Plains, represented by 200 farms in Jones County, and the High Plains Wheat Area. In all of the work under way the farms from which data are being obtained have been mapped as to soils, slopes, erosion conditions and vegetative cover by soils specialists of the Soil Conservation Service. These maps serve as the basis for an analysis of the soil and moisture conservation problems and practices on these farms. In addition, data are also obtained on the details of organization and operation of each farm and its component parts.

A preliminary report covering the work in the Black Prairie Area was issued during the year. The data obtained in Jones county are being analyzed and prepared for publication at an early date. The work being done in the High Plains Wheat Area was initiated during the year in cooperation with the Soil Conservation Service and centers around soil conservation projects in Deaf Smith, Oldham, Hartley, and Dallam Counties.

C. A. Bonnen, B. H. Thibodeaux, Bur. Agr. Econ.,
and A. C. Magee.

Quality as a Factor in the Marketing of Vegetables in the Lower Rio Grande Valley of Texas

This study has revealed the fact that, with the exception of potatoes and tomatoes, slight premiums, if any, are paid growers for vegetables grading No. 1 as against vegetables of lower quality. This failure of the local market fully to recognize quality in vegetables, however, has a somewhat different significance from the failure of the local market to recognize quality in a product like cotton. Under normal conditions the market outlets for vegetables under No. 1 quality are becoming more and more restricted. This has resulted from increasing supplies with resultant keener competition in the markets. Only under abnormal conditions when vegetable crops are short and demand relatively active is there a demand for the lower qualities. This is particularly true of vegetables like cabbage, carrots, and beets.

The results of this study are being brought together in manuscript form and will be submitted for publication during the coming year.

W. E. Paulson.

Central and Local Market Prices of Wheat in Relation to Quality

(In cooperation with the School of Agriculture, A. & M. College of Texas, and the Division of Chemistry)

Under the accepted procedure followed in the local grain markets of the Panhandle area of Texas, grade is a factor determining the price paid growers. The most significant aspect of grade is the test weight per bushel. In most instances, for wheat below the standard weight of 60 pounds per bushel, a fixed amount per pound is deducted from the price.

The question may be raised as to the effect of the recognition of test weight during years when protein content commands a premium. In order to determine the relation between test weight and protein content, correlations were run between these factors on the samples collected in connection with this project. The following results were found: for the 229 samples collected in 1931 the correlation was —.52±.03; for the 215 samples of 1933, —.77±.02; and for the 288 samples of 1934, —.99±.01. For the 732 samples collected during the three year period, the correlation was —.63±.02.

It would seem that these correlations are sufficiently high to be of significance. This means that during years when protein premiums are recognized by the market, growers marketing the lighter test weight of wheat while adding to the average protein content of the local point suffer deductions because of the grade.

The results of this study are being brought together in manuscript form and will be submitted for publication during the coming year.

W. E. Paulson, G. S. Fraps, and R. T. Stewart.

Operating Costs and Financial Conditions of Gins in Texas

(In cooperation with the Cooperative Division, Farm Credit Administration. This cooperation pertains to cooperative gins only.)

In the work done under this project until the present year, attention has been given to cooperative gins solely. But the project is so stated as to include private gins also. During the year, ginning cost data have been collected on forty private gins. The records on most of these gins cover the five ginning seasons 1932-33 to 1936-37.

The cost data of the private gins were itemized under nine headings. The cost items which have been collected on cooperative gins were combined and adjusted so as to conform with those of the private gins. A total of 519 usable cost records, the cost of a gin for a single season, have been obtained. This number permits a cost analysis both according to size of gin and type of power. It is contemplated that in the near future, a preliminary report will be prepared on the findings of the cost analysis.

Daily labor and ginning records on thirty gins for the seasons 1935-36 and 1936-37 have been obtained. These data show: size and personnel of the ginning crew; the number of hours of work for the day, regular and overtime, if any; the rate of wages; and the number of running bales and the weight of seed cotton ginned. An analysis of these data should reveal the possibilities of expressing labor cost in physical units, hours of labor per bale. Dollar cost involves two variables, the relative efficiency in the use of labor and the wage scale. High labor costs may be due to a high wage scale, or to inefficient use of labor, or both. These daily records should permit an analysis of labor costs both in terms of labor efficiency and wage scale.

Since cooperative gins with profits to distribute to members, in the main, use the patronage dividend, the various ways of computing this dividend should be of interest Two distinct processes are involved: (1) a determination of the rate of the dividend; and (2) an application of this rate to the patronage of the members. In Texas, some five methods for computing the patronage dividend are in vogue: by the running bale; by the number of pounds of lint cotton ginned; by the number of pounds of seed cotton ginned; by the running bale, or pounds of seed cotton ginned and pounds of cottonseed bought from members; and by departments. For the season 1935-36, 48 per cent of the cooperative gins of Texas used the running bale method; 26 per cent used the lint weight; and 8 percent used the departmental. Under the latter method, profits are computed for each department of the ginning business. Profits of ginning, ginning toll less cost of ginning, are distributed to members according to the weight of seed cotton each member ginned; profits on bagging and ties are distributed according to the number of patterns bought by each member; and profits on cottonseed handled by the gin are distributed according to the weight of cottonseed sold by each member to the gin association. It would seem that the departmental method is the most equitable in that each member shares in the profits of each department according to his contributions to the profits of such departments.

Data as to the number of bales, the pounds of seed cotton, and the pounds of lint cotton ginned, by each member as well as the pounds of cottonseed each member sold to the gin, were obtained from three gins for the season 1935-36. The effect on the amount of the patronage dividend to each member according to the various methods of computation was determined for one of these gins. Using the departmental dividend as the standard, the percentages of ginnings by members which would have yielded a patronage dividend within the range of five per cent above, or below, that of the departmental would have been as follows: by the lint weight method, 36; by the running bale, 48; by the seed cotton weight, 64; and by the running bale and weight of cottonseed, 83. A number of gin associations, in recent years, have changed from the running bale method to the lint weight. According to the above analysis, this would seem to be moving in the wrong direction. The departmental method is growing in popularity.

L. P. Gabbard and W. E. Paulson.

Trend of Taxes on Farm and Ranch Real Estate in Texas

Schedules have been completed for 160 counties in the State, completing the tax information for farm and ranch lands through 1936, and through 1937 for a considerable number of these counties. These data, along with farm price data, are being summarized and will be published during the coming year in mimeograph form as a supplement to Texas Station Bulletin No. 512, "Trend of Taxes on Farm and Ranch Real Estate in Texas." Bulletin No. 512 shows the trend of taxes on farm and ranch lands for the period 1913-1933, inclusive. This mimeographed supplement will show the taxes on about 58 counties as far back as 1890, and will include data on the entire 160 counties for the period 1913-1936, inclusive.

Costs and Services of Local Government in Texas

The results of the study of the costs and services of local government in Texas were published, April, 1937, in Station Bulletin No. 540, "Possible Savings Through Changes in Local Government."

The analysis of county expenditures as presented in this bulletin reveals three important points: (1) Many of the smaller counties have insufficient resources to maintain adequate services without increasing costs tremendously as compared with those of the larger counties; (2) the plan of organization should be improved in all counties, regardless of size; and (3) the State should take an increased interest in the responsibility for the work performed in the counties. Such work includes budgeting; accounting and auditing; assessing and collecting taxes; creating and administering indebtedness; selecting officers and employees; and enforcing laws.

The savings from consolidation are largest in the counties having fewer than 5,000 people, and they gradually decrease as the population increases. Apparently these savings become insignificant after a population of 35,000 to 40,000 is reached. Using the costs of the county having a population of 20,000 as a standard, we estimate that consolidation would save $2.91 per capita in the counties having fewer than 5,000 people. This amount is equal to 21 per cent of the total cost of county government, 25 per cent of the operating costs, and 63 per cent of the costs affected by consolidation.

The adoption of the county manager or county executive plan should provide substantial savings. In the county of 20,000 population, it is estimated that $10,000 to $15,000 per year might be saved in salaries. In addition, the savings in purchasing equipment and supplies and in operating all services should approach the savings in salaries in many instances. A third and slightly different type of saving arises from the increased efficiency of all services rendered. This would not be a saving in the sense of reducing taxes, but it would be a saving in the sense of providing more for the money.

L. P. Gabbard and H. C. Bradshaw.

Economic Significance of Different Farm Leasing Systems in Texas

Considerable progress has been made during the past year in carrying out the objectives of this project. Including the work in cooperation with the United States Department of Agriculture, facts concerning leasing systems and verbal rental agreements have been obtained from approximately 1,000 farmers located in several different type-of-farming areas. In addition, an analysis of the incomes of landowners and tenants has been made from 450 farm management records taken on tenant farms. All of the above data have been tabulated in summary tables and are now being given careful study. In order to test the significance of the findings it will be necessary to make some further statistical analysis. However, some preliminary results are available and are summarized below.

In periods of low prices or low production of cash crops, net farm incomes go down, but the tenant's percentage of that net income usually goes up because he has considerable "living from the farm" which is not generally shared with the landowner. Also it is to be remembered that the landowner's fixed costs of interest and taxes do not go down as quickly as do the tenant's operating costs. On the other hand, when prices and production go up the *landowner* receives a larger percentage of the net income.

Another significant fact brought out by this study is that many tenants are making higher net incomes as tenants than they could make as owners on the same farms, assuming that they would have to pay five per cent for the money invested in farm property. This is no doubt one important reason why more tenants do not become farm owners.

This study further shows that from 80 to 90 per cent of tenant farmers want to own farms and are seriously looking forward to owning their farms. When questioned more specifically, however, less than 15 per cent of the tenants saw any good prospects of owning a farm within the next five years. Tenants everywhere are expressing a keen interest in the government's farm security program of home ownership for tenants.

It has been found that the old customary "third-and-fourth" system is breaking down in many areas. In some few cases tenants were found paying a one-third share of cotton, instead of a one-fourth share, as rent. Cash rent for feed land and pasture land is now quite common and seems to be increasing. The increase in livestock farming, stimulated by low cotton prices and reduced cotton acreages, is causing many landowners to find new means of collecting rent on feed and pasture land and on livestock income. The demand for livestock share agreements is increasing.

A comparison of tenant farms owned by absentee landowners as compared with those owned by resident landowners does not confirm the popular belief that the absentee landowners is wholly vicious. On the average, the farms of the absentee landowners seem to be just as well cared for as are the farms of resident landowners. In fact, the balance of the evidence seems to show that the absentee landowners are doing a better job of conserving the soil than are the resident landowners. More of the absentee landowners have written contracts with their tenants. Also the absentee landowner frequently hires some competent person or agency to give general supervision to his farm. Furthermore, absentee landowners, not being near enough to see after their property, usually try to get the most competent tenants to operate their farms.

The great majority—about 95 per cent—of all rental agreements in Texas are unwritten. About fifty per cent of all tenants interviewed expressed a preference for written lease contracts. However, a majority of tenants do prefer long term agreements, as well as compensation for improvements which they have put on the farm during their periods of tenancy. Many cases were found where landowners in one way or another did compensate their tenants for improvements placed on the land, but these cases represented a small minority and no uniform, systematic procedure had been worked out for making the compensation effective.

One of the practical results of this project has been the preparation of an experimental rental contract which is receiving considerable attention in the state. A number of conferences have been held with landowners and tenants, and many helpful suggestions have been made concerning its provisions. Some of the outstanding features relate to soil conservation, length of tenure, compensation for improvements, and arbitration of differences between landowners and tenants.

L. P. Gabbard and C. H. Hamilton.

Cooperation with the Division of Social Research of the Works Progress Administration

This Division supervised two major surveys, during the year, dealing with the current relief situation in Texas. This was done under a cooperative agreement between the Texas Agricultural Experiment Station and the Works Progress Administration. DRS-160-162 included 26 sample counties in Texas, and DRS-275 covered three selected counties in the drought area of northwest Texas. DRS-160-162 was conducted to obtain the intensity, the cost, and the trend of public and private assistance. It included a complete inventory of all active agencies in the selected counties. DRS-275 served as a basis for obtaining, by months, a complete and unduplicated count of families receiving public assistance and the extent and direction of movement of families out of the drought area.

During the year, two statistical bulletins (mimeographed) have been published under the following titles:

4. "The Youth in the Texas Rural and Farm Relief Population" (September, 1936.)

5. "A Study of Family Heads and Other Members in the Texas Rural and Town Relief Population" (February, 1937.)

L. P. Gabbard and C. E. Ullrich.

BOTANY

The identity and distribution of native vegetation is of considerable importance to the study of agricultural problems. Vegetation is an important tem in furnishing feed for livestock. Some species of vegetation when eaten are harmful to livestock. Many species have value as honey producers. Plants also act as carriers of plant diseases and in this way have an important relation to agriculture.

The study of native vegetation in relation to the livestock industry is centered around the work at the Ranch Experiment Station. It involves principally the occurrence of species which make up the range feed values and the occurrence of species which are harmful to livestock or have low range feed values. The study of the sequence of the different species also widens our knowledge of the extent to which these may affect range feed values.

The work in connection with honey plants is centered at the Apicultural Research Laboratory near San Antonio and is reported under the Division of Apiculture.

The study of vegetation as carriers of plant diseases is centered at Substation No. 5, Temple, primarily in connection with cotton root rot disease work. Some additional work with plants as weed pests is being carried at the Winter Garden Station and at the Apicultural Research Laboratory.

Through the efforts of Mr. H. B. Parks and others, there has been developed at the Agricultural and Mechanical College of Texas a herbarium comprising some fifty thousand species, which, within another year, should be mounted and catalogued for reference purposes.

V. L. Cory.

SWINE HUSBANDRY

Quantitative Requirements of Vitamin A for Pigs

This project is to study quantitatively the requirements for pigs of vitamin A as to gain, economy of gain, and the quantity of vitamin A needed by brood sows to produce uniform pigs of high vitality.

In January, six four-months-old sow pigs were placed in individual pens in dry lot and each fed a ration containing approximately two hundred micrograms of carotene in the form of alfalfa meal, per 100 grams of feed. General condition and gains were satisfactory. The gilts were bred to farrow in the fall and pigs from these litters will be selected when weaned and placed on rations containing varying amounts of vitamin A potency.

F. Hale, G. S. Fraps.

Methods of Feeding Brood Sows

This study relates to methods of feeding brood sows as to the effect on the general health and condition of the sows during both the gestation and lactation periods, the effect on the litter at birth, and the saving of labor.

Fifteen sows were hand-fed once and ten sows twice per day during the year. Observations this year again show that the once a day feeding gives as good results as does the twice a day feeding. By giving the day's feed allowance in one feeding, half the labor required for feeding is saved. The condition of the sows throughout the gestation period was as good as the once a day as it was on the twice a day feeding. The pigs from sows fed nce per day were equal in size and vigor at birth to those from sows that ere fed twice per day during the gestation period.

After the pigs are two weeks old, however, the results this year indicate at the sows should be fed either twice per day or the sows and pigs hould be fed by the self-feeder method. During the lactation period it is ifficult to hand feed the sows the day's ration at one feeding without causng the pigs to scour.

F. Hale.

Sudan Grass and Oats Pasture for Fattening Hogs

One 90-day test was made with sudan grass and one with oats pasture is year. Ten pairs of pigs were used in each test and were fed individually nd had access to individual pasture lots. The pasture was grazed at the ate of eighteen pigs per acre.

With sudan grass, the pigs made an average daily gain of 1.54 pounds as ompared to 1.52 pounds for the dry lot fed pigs. The dry lot fed pigs equired 326 pounds of whole kafir and 64 pounds of protein supplement er 100 pounds of gain. The pigs with access to sudan pasture required 28 pounds of whole kafir and only 48 pounds of protein supplement per 100 ounds of gain. Thus it is seen that the greatest value received from e sudan grass was in the saving of high-price protein supplement. This aving amounted to 374 pounds of protein supplement per acre of sudan rass for the 90-day period.

The oats pasture test was made in December, January, and February. he pigs on oats pasture gained 1.81 pounds while the pigs in dry lot ained 1.88 pounds per pig daily. The dry lot fed pigs, however, required 4 pounds more grain and 12 pounds more protein supplement per 100 ounds of gain. The larger gains made by the pigs on oats pasture as ompared to those made by pigs on sudan grass is due in part to climatic nditions, as our tests show that pigs will consistently gain more when the tside temprature is around 55° F. than they will when the temperature erages around 85° F. Sudan grass is grazed in June, July, and August ring the 85° F. temperature.

F. Hale.

Calcium Requirements of Growing and Fattening Pigs When Fed Rations Balanced with Cottonseed Meal

The calcium was supplied in the rations used in these tests in the form of nely ground oyster shell flour containing 54.57 per cent CaO. Pigs getting e ration containing no oyster shell flour gained only 0.9 pounds per day ring the 90-day tests and required 398 pounds of feed per 100 pounds of in. The pigs getting one per cent of oyster shell flour in their ration ade an average daily gain of 1.21 pounds per pig and required 392 pounds feed per 100 pounds of gain. The pigs getting two per cent of oyster shell flour in their ration gained 1.12 pounds per day per pig and required 402 pounds of feed per 100 pounds of gain. The initial weight of the pigs used in these tests was 69 pounds and twenty-four pairs of pigs were fed individually. No advantage was gained by adding as much as two per cent of oyster shell in the ration.

F. Hale.

Storing Sliced Cured Bacon in Different Oils

In cooperation with the Division of Rural Home Research, results obtained from storing sliced cured bacon at room temperature from April to October, 1937, in refined cottonseed oil proved unsatisfactory because of the unattractive appearance, texture, and off flavor of the bacon. The bacon was stored as follows: in a crock with loosely fitted cover; in a jar with perforated paper cover; in sealed jars; in sealed cans; and in sealed cans processed at 15 pounds pressure for 15 minutes. Tests for palatability were made at monthly intervals.

Sylvia Cover and F. Hale.

Utility of Rice and Rice By-Products for Growing and Fattening Hogs

No work was done on this project this year.

F. Hale.

Storing Pork in West Texas

The work under this project is done chiefly at Substation No. 6, Lubbock, and results are given in the report of that Station.

Effect of Maternal Vitamin A Deficiency Upon Development of Animal Embryos

Work on this project has been temporarily suspended.

F. Hale and G. S. Fraps.

DAIRY HUSBANDRY

Vitamin A Requirements for Milk Production and Maintenance of Dairy Cows

This project has been completed and the results published in Station Bulletin 536 entitled "Utilization of Vitamin A by Dairy Cows." It was found that the vitamin A potency of the butter is closely related to the vitamin A potency of the feed and the period of time the cow has been receiving it. The results indicated that from 750,000 to 1,400,000 Sherman-Munsell units are required per cow daily to produce butterfat containing from 65 to 95 Sherman-Munsell units per gram, the amount found in very good butter. The average utilization by the cows of the carotene in the feed in transferring it as vitamin A potency to the butterfat was very low, only about 2.5 per cent.

G. S. Fraps and O. C. Copeland.

The Quantitative Requirements of Vitamin A for Dairy Cattle

This project has been conducted in cooperation with the Division of hemistry as outlined in the previous report. Three groups of six calves ach at weaning age were placed on a daily allowance of 1000, 2000, and 500 micrograms of carotene per 100 pounds liveweight. The calves are eing weighed at 14-day intervals and the carotene content of the alfalfa eaf meal is being determined at the same intervals to make adjustments n feed allowance so that the proposed carotene levels can be maintained s the experiment progresses. Liveweights and body measurements are sed to determine rate of growth. During the first year of the experiment satisfactory rate of growth has been obtained in all three groups of eifers. However, night blindness, a characteristic symptom of vitamin A eficiency, has been detected at times in individuals of all three groups.

One experiment to determine the effect of a deficiency of vitamin A on nilk yield has been completed. This was a double-reversal experiment nd 126 days were used for the entire experiment. The cows produced pproximately 10 per cent more milk while on a daily allowance of 15,000 nicrograms of carotene per 100 pounds of liveweight than when fed only ,500 micrograms of carotene daily per 100 pounds liveweight. This exeriment will be duplicated again this year in an attempt to confirm the esults of the first experiment.

O. C. Copeland and G. S. Fraps.

Permanent Pastures for East Central Texas

Because of the dry weather only one clipping yield was obtained this year rom the plats treated with different kinds and amounts of fertilizers. The lats are being maintained for further study next year.

O. C. Copeland and E. B. Reynolds.

Minerals Necessary in Commercial Dairy Feeds

No work has been done on the project this year.

O. C. Copeland.

Cottonseed Meal and Hulls As a Ration for Lactating Dairy Cows

The data from this project are being analysed preparatory to publication s a Station bulletin. The results indicate that cottonseed meal and hulls re not a complete feed and if fed alone over a sufficiently long period of ime will cause disastrous results, mainly from the standpoint of vitamin deficiency. Silage, when fed free-choice along with cottonseed meal and ulls, did not supply enough vitamin A potency for a normal milk flow r satisfactory reproduction in dairy cows. Good results were obtained rom feeding cottonseed meal and hulls when pasturage was supplied in ddition.

O. C. Copeland.

Bangs Bacillus Disease (Bovine Infectious Abortion)

This study is a cooperative project between the Division of Veterinary Science and the Department of Dairy Husbandry, School of Agriculture, and the Division of Dairy Husbandry. That part of the project directly concerning the Division of Dairy Husbandry has been completed. It was our object to eradicate the disease from the herd by the method whereby calves at five months of age were moved from the infected herd and premises and kept isolated until all infected cattle had been removed from the infected premises and enough time elapse to allow all infection to pass away before the isolated abortion-free cattle were brought back to the original premises. This has been accomplished and required approximately seven years from the time the first calf was placed into the isolated quarters until a herd built up in this manner was returned to the original premises free of Bangs disease. Other information on this project can be found in the report of the Division of Veterinary Science.

H. Schmidt and O. C. Copeland.

Factors Affecting the Quality of Southern Short Cure Cheddar Cheese

(In cooperation with School of Agriculture, A. & M. College.)

In the past year, preliminary work was conducted to determine some of the factors that affect the quality of Cheddar cheese made from pasteurized milk. Preliminary tests indicated that high temperature of curing was the most promising factor studied. Hence the project will be revised in 1938 to study this factor in detail. Other factors studied were effect of washing the curd, amount of rennet, and the amount of salt added to the curd.

Cheese made by the washed curd method was frequently flat and metallic in flavor.

When the standard amount of rennet was increased threefold, bitter flavor developed, which persisted during four months that the cheese was held in cold storage.

When the amount of salt was reduced in the attempt to increase the rate of curing, flat and fruity flavors often resulted.

F. E. Hanson, C. N. Shepardson.

Methods of Manufacture and Other Factors Affecting the Quality of Butter

Various trials are being made to improve the technique in conducting various tests which can be used to determine the quality of butter. These include such tests as Reichert-Meissl, Polenske, Melting point, saponification, iodine number, hardness, and Kohman.

Monthly samples of butter from a creamery in each of several sections of the State are being analyzed to determine the location and degree of

uch defects as gummy, brittle, and hard body and flat, tallowy, and oily
lavors.

F. E. Hanson, C. N. Shepardson.

POULTRY HUSBANDRY

Slipped Tendon Studies

During the year, in cooperation with the Division of Chemistry, two
xperiments were conducted on this project, using a total of 652 chicks.
he basal diet, known as Diet 1, was composed of ground milo—20 pounds,
round yellow corn—59 3/4 pounds, meat and bone scraps—9 pounds,
ried skimmilk—9 pounds, chick size oyster shell—1 pound, salt—1 pound,
nd fortified cod liver oil—1/4 pound. In Diet 2, the ash from 20 pounds of
vheat gray shorts replaced a like weight of ground milo in Diet 1. In
iets 3 to 8, inclusive, combinations of mangnese, aluminum, and iron were
ed in the form of the sulphate. In Diet 3, 1.68 grams of manganese was
dded to Diet 1. In Diet 4, 1.68 grams of manganese and 1.20 grams of
luminum were added to Diet 1. In Diet 5, 1.68 grams of manganese, 1.20
rams of aluminum, and 1.20 grams of iron were added to Diet 1. In Diet
, 20 pounds of wheat gray shorts replaced the 20 pounds of ground milo
n Diet 1. In Diet 7, 1.20 grams of iron and 1.20 grams of aluminum were
dded to Diet 1. In Diet 8, 1.68 grams of manganese and 1.20 grams of
ron were added to Diet 1.

These diets were fed fourteen hours per day for twelve weeks to white
eghorn chicks. The slipped tendon or perosis index was figured from
ata secured at the close of the experiment. These indexes were calculated
s follows: Each chick was given a value of zero, one, two, and three as
ompared with no slipped tendons, a slight case, a medium case, or a severe
ase. These values were added, the sum was divided by three times the
umber of chicks, and the quotient was multiplied by 100. The higher the
ndex, the more severe the trouble. The accompanying table gives the data
n the number of cases of slipped tendons and their severity, the slipped
endon index, and the mean gains in live weight for the chicks on the dif-
erent diets. Diets 1, 3, 5, and 6 were fed to duplicate lots of chicks in
oth experiments, while Diets 2, 4, 7, and 8 were fed to single lots of
hicks in both experiments. It is noted from the table that the slipped
endon index for each diet except 1 and 7 was low. Diet 1 was the basal
iet, and Diet 7 contained aluminum and iron. All diets containing man-
anese prevented slipped tendons reasonably well, but the one containing
anganese and iron produced poor gains. It is possible that the beneficial
esults of wheat gray shorts and ash of wheat gray shorts may be due in
art to the manganese in this feed.

R. M. Sherwood and G. S. Fraps.

Summary Table Giving Number of Chicks With Slipped Tendons, Slipped Tendon Index and Mean Gains for the Various Diets

Feed (Variable in Diet)		Number of Chicks	Slight Slipped Tendons	Medium Slipped Tendons	Bad Slipped Tendons	Slipped Tendon Index	Mean Gain in Live Weight
Diet 1	Basal Ration.............	83	11	17	20	42.2	424.11
Diet 2	Ash of Wheat Gray Shorts..	36	1	3	0	6.5	470.85
Diet 3	Manganese...............	84	1	0	1	1.6	485.20
Diet 4	Manganese and Aluminum.	37	1	0	0	0.9	445.11
Diet 5	Manganese, Iron and Aluminum..............	79	5	2	1	5.1	455.04
Diet 6	Wheat Gray Shorts.......	87	3	0	0	1.1	630.13
Diet 7	Aluminum and Iron.......	31	7	4	3	25.8	376.24
Diet 8	Manganese and Iron......	41	1	1	0	2.4	378.11

Vitamin D Requirements of Chickens

In this project, conducted in cooperation with the Division of Chemistry, two levels of Vitamin D, 3.3 and 6.6 International (U. S. P.) Units of Vitamin D per 100 grams of ration, were studied during 1937, each on levels of 1.05 per cent calcium and .55 per cent phosphorus with a calcium:phosphorus ratio of 1:0.52, 1.08 per cent calcium and .65 per cent phosphorus with a calcium:phosphorus ratio of 1:0.60, and 1.47 per cent calcium and .65 phosphorus with a calcium:phosphorus ratio of 1:0.44.

In every case, the gains in live weight were significantly lower on levels of 3.3 International Units of Vitamin D than on the 6.6 International Units of Vitamin D. The mean percentage of ash in the tibiotarsus bones of the chickens was lower on the 3.3 units level than on the 6.6 units level. The amount and severity of rickets was worse on the lower level of Vitamin D than on the levels of 6.6 units per 100 grams of feed.

The advantage of the 6.6 units of Vitamin D on the mean percentage of bone ash and amount and severity of rickets as compared with the lower level was more marked with the ration containing 1.08 per cent calcium and .65 per cent phosphorus with a calcium:phosphorus level of 1:0.60 than on the other mineral levels studied.

Levels of Vitamin D higher than 6.6 International Units per 100 grams of feed would, no doubt, have given better results than the levels studied as the mean percentage of bone ash for the 6.6 units of Vitamin D groups were low (39.5 per cent to 44.4 per cent bone ash) and some rickets resulted from the feeding of this level.

Two experiments were conducted with chicks brooded away from sunlight and receiving rations containing approximately 1.63 per cent calcium and .78 per cent phosphorus. Lot 1 received no Vitamin D, Lot 2 received two hours exposure to sunlight per week, Lot 3 received 3.3 International (U. S. P.) Units of Vitamin D per 100 grams of feed, Lot 4 received 6.6 units, Lot 5 received 9.9 units and Lot 6 received 13.2 International Units of Vitamin D per 100 grams of feed. The results, as judged by the gains live weight, mean percentage of ash in the tibiotarsus bones, and the nount and severity of rickets indicated that 13.2 units of Vitamin D ere required for best results.

Three experiments of six groups each were fed the diet of the Associa- on of Official Agricultural Chemists with varying amounts of Vitamin D om cod liver oil. The data from these experiments indicate that the inimum Vitamin D requirements under the conditions of these experi- ents as determined by the mean percentage of bone ash and gains in eight of the chickens is approximately 16 International Units of Vitamin per 100 grams of diet.

The cod liver oil used in all of these experiments had had the Vitamin A estroyed by heat and aeration. This oil was assayed with rats by the ne test which might cause these results to vary from what they would ve been had the oil been assayed with chickens.

J. R. Couch, G. S. Fraps, and R. M. Sherwood.

Vitamin A Requirements of Chickens

Work on this project, conducted in cooperation with the Division of hemistry, has been continued along the lines reported in the 49th annual port. During 1936-37, three lots of 20 hens were fed all-mash rations ntaining 200, 300 and 400 micrograms of carotene per 100 grams of feed. uring the year, 16 hens died from the lot of hens receiving 200 micrograms carotene, 11 hens from the lot receiving 300 micrograms of carotene, d 10 hens from the lot receiving 400 micrograms of carotene; the egg oduction for the various lots was 49, 75 and 107 respectively.

In the study to determine the Vitamin A requirements of growing ickens, six experiments of six lots each were conducted. The carotene vels studied were 50, 75, 100, 125 and 175 micrograms per 100 grams of ed. The gains of the chickens to 12 weeks of age, the mortality and the r cent of chickens showing Vitamin A deficiency symptoms at the close the experiment were measures used to determine the requirements. om these studies, it would appear that from 100-150 micrograms of caro- ne per 100 grams of feed were sufficient for Leghorn chickens up to elve weeks of age.

R. M. Sherwood, G. S. Fraps.

Calcium and Phosphorus Requirements of Chicks

Four experiments were conducted on this project with chicks on only International (U. S. P.) Units of Vitamin D per 100 grams of feed to udy the calcium and phosphorus requirements. Ration 1 contained 1.05 r cent calcium and 0.55 per cent phosphorus with a calcium:phosphorus tio of 1:0.52. Ration 2 contained practically the same amount of cal- m as Ration 1, but more phosphorus. It contained 1.08 per cent calcium d 0.65 per cent phosphorus with a calcium:phosphorus ratio of 1:0.60. tion 3 contained the same amount of phosphorus as Ration 2, but contained more calcium. It contained 1.47 per cent calcium and 0.65 per cent phosphorus with a calcium:phosphorus ratio of 1:0.44.

On this low level of Vitamin D, Ration 2 gave the poorest gains and had the most rickets of the three rations. Ration 3 gave much better gains, a higher percentage of bone ash and less rickets than either of the other rations.

Two experiments were conducted with the same calcium and phosphorus levels as in the previous mentioned experiments, but with 6.6 International (U. S. P.) Units of Vitamin D per 100 grams of feed. In these experiments, the gains for the chicks fed Ration 3 with the higher levels of calcium and phosphorus were significantly higher than for the chicks on either of the other rations. The gains of the chicks on Ration 2 were slightly higher than on Ration 1. The percentage of bone ash was greatest for the chicks on Ration 3 and lowest for those on Ration 1. The greatest amount of rickets developed in the chicks fed Ration 1, and the least amount developed in the chicks fed Ration 3.

These experiments indicate that the calcium and phosphorus requirements and the ratio between the amount of calcium and the amount of phosphorus are more exacting on the lower level of Vitamin D than on the higher level.

R. M. Sherwood, J. R. Couch.

RURAL HOME RESEARCH

Factors Affecting the Storage of Cucumbers

In this project, cooperative with the Division of Horticulture, cucumbers shipped from Substation No. 19 at Winter Haven were stored in the laboratory of the Division of Rural Home Research. Some of these fruits were wrapped individually in moisture proof cellophane at the time of harvesting the remainder were unwrapped. Both wrapped and unwrapped fruits were stored on an open shelf in the laboratory (average temperature 89.7°F at 8 a. m.) and in an electric refrigerator (35°F-40°F), some of the unwrapped ones in the refrigerator being placed in the humidifier. After 14 days of storage, the losses in weight were: for wrapped cucumbers—on the laboratory shelf 5.1% of the original weight, in the refrigerator 3.6% for unwrapped fruits—on the laboratory shelf 13.8%, on the refrigerator shelf 9.4%, and in the refrigerator humidifier 3.0%. These results resemble those in similar tests made the preceding two seasons. Sample fruit from these tests, after storage varying from 1 to 29 days, were scored independently by six judges on turgidity, texture, flavor, and palatability Ratings on palatability (all qualities together) will illustrate the results The highest rating of a wrapped fruit on the laboratory shelf was "fair (at 5 days); unwrapped fruits on the laboratory shelf were "good" only up to 3 days; "good" to "excellent" was given the fruits in the refrigerato ıp to 10 days for unwrapped on the shelf; to 14 days, for wrapped; and o 16 days, for unwrapped in the humidifier.

In another type of storage tested, unwrapped cucumbers grown at Col-ege Station were packed in containers suitable for shipping (a bushel ize wood crate, a half bushel splint basket, a smaller corrugated paper ox, each previously lined with moisture proof cellophane) and stored in an lectric refrigerator (average temperature 39°F. at 8 a. m.). The results vere in every respect similar to those in previous tests with unwrapped ruits in the humidifier and with fruits wrapped individually in cellophane nd stored in a refrigerator.

An intensive study of the effect of storage on quality was made with ucumbers grown at College Station. Some were judged on the day of arvesting, others after storage for 2, 4, 6, 8, 10, 12, and 14 days, un-vrapped, on the shelf or in the humidifier of the refrigerator. The six udges scored each cucumber as in other tests. Aside from the influence f bitterness on flavor and palatability alike on fresh and stored fruits, he cucumbers in the humidifier remained much more acceptable throughout he two weeks test period than did the fruits on the refrigerator shelf.

From the results of this study it appears that cucumbers wrapped in-ividually in moisture proof cellophane, or placed unwrapped in a cellophane-ined container, or in a humidifier and stored in a refrigerator will remain, or 8 days, practically as desirable as fresh and for 2 weeks most of them vill be acceptable though not in choice condition.

Jessie Whitacre, L. R. Hawthorn, S. H. Yarnell.

Effect of Tea Upon the Energy Metabolism of Children

Analyses of findings thus far indicate that among children 10 to 13 years ld oxygen consumption as measured by a Benedict-Roth recording respira-ion apparatus was very little if any increased by the caffein (average mount .0292 gram) in 300 cc of ice tea. It is planned to secure data upon everal other children in the summer of 1938 before the final report of this tudy is prepared.

Jessie Whitacre.

The Effect of Oven Temperatures on the Tenderness of Meat

The result of tests using high (225°C) and low (125°C) oven tempera-ures in gas ovens were reported in Bulletin 542—"The Effect of Tempera-ure and Time of Cooking on the Tenderness of Roasts." In this bulletin relationship between tenderness and slow cooking was reported based n the following observations: A significant difference in tenderness be-ween paired roasts cooked at high and low oven temperatures was not ob-ained consistently for all cuts, but some cuts consistently required more ooking time at the low oven temperature than did others. In these cuts he average difference in time of cooking between the high and the low oven temperature methods was consistently long and the percentage of judgments in favor of the low oven temperature method was consistently high.

After consideration of these results, further experiments were undertaken to test the effect of difference in cooking time on the tenderness of meat. As it was known that the time of cooking can be shortened by using metal skewers stuck into a roast, skewers were used to decrease the time of cooking of one roast in each pair. The roasts were then cooked well-done at the same (125°C) oven temperature. The decrease in cooking time obtained in the skewered roasts was associated with a decrease in tenderness.

The results of all of these experiments seem to show that tenderness is affected by differences in time of cooking more than by differences in oven temperature and that slow cooking produces a more tender roast than does fast cooking.

Sylvia Cover.

Processing of Canned Meat

Inoculations with the Memphis strain of Clostridium Botulinum have been made in ground beef canned in two sizes of cans which were then processed at 15 pounds pressure for one hour—a period frequently recommended to homemakers. Some of the cans were stored for periods of time ranging from eight days to four weeks before opening for tests. No toxin was produced, and no cultures could be grown later on cube liver bouillon.

Two inoculated cans which were not processed showed gas formation after two days. Twelve days after canning these showed marked toxin production. Some of the inoculated processed cans, however, are still in the incubator and no gas formation is evident after fourteen months.

For the strain used in these tests processing for one hour at 15 pounds pressure appeared to be sufficient for complete destruction, but, since tests for heat resistance of the spores could not be made at the time of inoculation, general conclusions cannot be drawn. The spores used may not have been as resistant to heat as some others, even though they were very efficient in toxin production.

The work is being continued.

Sylvia Cover, R. D. Turk, and H. Schmidt.

Storing Cured Bacon in Oil

The final results of this study are found under the Division of Swine Husbandry.

Effect of Degree of Fatness on Tenderness and Flavor of Lamb

In cooperation with the Department of Animal Husbandry of the College and the Division of Range Animal Husbandry, tests have been begun using lambs produced on one ranch where the same blood lines had been used for ten years. Through cooperation with the ranch owner the lambs were selected for uniformity in type and size from the entire crop of lambs.

After a short period of acclimatization eight of the lambs were killed (previous feed being range grass and milk only). The remaining forty were then full-fed a ration of yellow corn, cottonseed meal, and alfalfa hay. After six weeks on feed eight lambs were killed and eight more at two-week intervals to the end of the test.

The carcasses were graded by a committee of animal husbandmen.

The legs and short racks were separated from four of the carcasses after eight days and from the other four after fifteen days storage in the cooler. These cuts from the right side were used for analysis and from the left side for cooking and palatability tests.

The test has not yet been finished and no conclusions can be drawn at this time.

Sylvia Cover, A. K. Mackey, and C. E. Murphey.

Physical Characteristics in Cotton and Their Interrelationship

Half and Half and Lightning Express, with succeeding generations of hybrid lines resulting from a cross of these two varieties are being used. The cotton was furnished by the Division of Agronomy.

Thus far measurements of physical characteristics have been confined to strength, maturity, and fineness.

Half and Half was found by the Chandler method to be approximately 80 per cent as strong as the Lightning Express.

The percentage immaturity of each of the two parent cottons has been determined by the sodium hydroxide and the polarizing microscope methods. Two observers working independently, each using one method, determined the number of mature and immature fibers in a total of over 1500 fibers for each variety. By the sodium hydroxide method the Half and Half had a percentage immaturity of 12.8, and by the polarizing microscope 13.8. The percentage immaturity of Lightning Express was 25.4 by the sodium hydroxide method, and 26.8 by the polarizing microscope. Since these percentages are at least as close as can be obtained by duplicate determinations, it is concluded that the polarizing microscope may be used for percentage immaturity. It has the advantage over the sodium hydroxide of being much more rapid and of leaving the fibers in their original state for further study.

Cross sections have been made with the Hardy device, the sections projected and the area measured with a planimeter. It was found that 250 fibers from each plant must be measured to keep the standard error as a percentage of the mean to 2 per cent. The cross sectional area of fibers from six plants each of the Lightning Express and Half and Half has shown the Lightning Express to be approximately 70 per cent as great as that of the Half and Half.

In an attempt to make the outline of the fibers more distinct when projected, fibers were dyed with Ruthenium Red. Measurements of the cross sections of 100 fibers thus dyed indicate that the dye materially increases the area. Further measurements will be made to test this method.

When mature fibers were treated with 18 per cent sodium hydroxide, and the diameter of the fiber, the thickness of the wall, and the width of the lumen measured, it was found that the diameter of Lightning Express was approximately 85 per cent, the wall thickness 79 per cent, and the lumen 108 per cent as great as that of Half and Half.

Further measurements, including fineness by the weight per unit length method, are being made on the parents. Measurements of the fibers from the F_1 and F_2 generations are under way but as yet too few to report.

Mary Anna Grimes.

Study of Body Measurements for Sizing Children's Garments and Patterns

This project is part of a cooperative one between the Bureau of Home Economics and eight states. It is being done for the primary purpose of providing a scientific basis for standardizing children's garments and patterns. In Texas, cooperating agencies include the schools (public, independent, parochial), and the local permanent offices of relief agencies in the measuring centers (thus far Denton, Dallas, Lubbock, and San Antonio); the NYA, and WPA state organizations; the Home Economics Extension Service of A. & M. College; North Texas State Teachers College; Texas State College for Women; Texas Technological College; and Texas Agriculture Experiment Station.

Measurements on 6000 to 10,000 native born white children six to fourteen years of age in Texas are desired. Records for over 3500 have been secured. Each measurer has had intensive training by an anthropometrist to make the thirty-six measurements being taken on each child. These measurements include not only those common in school health programs, such as weight, hip width, and stature, but also others that are specifically needed and especially important for garment and pattern construction—for example, girth of the chest at different levels, and front and back width of chest, depth of arm-scye, girth of arm-scye, girth of neck base, length of shoulder, slope of shoulder, length of arm with elbow bent, girth of elbow bent at right angle, height of knee, and of crotch, vertical girth of the trunk, and extreme bend. Collection of data is expected to be completed by May, 1938.

Jessie Whitacre.

APICULTURE

The Apicultural Research Laboratory, comprising 10 acres of land, is located near San Antonio with a yard near Dilley and an outyard in cooperation at Roxton.

Activities of Bees

The definite responses of the bees to weather conditions as shown by the observations taken during the year of 1937 are extremely interesting in that the weather conditions were of such a character that the bees had to meet a set of circumstances that were very much unlike any conditions upon which observations have been made at this Station. The bees went into winter quarters with heavy winter supplies which normally would have resulted in a large field force and good spring honey crop. The first part of January was definitely advantageous to the bees. The normal rainfall occurred. Because of low temperatures the bees were quiet and utilized but small amounts of honey. From the last week in January to the last week in May a constantly increasing drought occurred. The lack of rainfall and prolonged low temperatures deferred brood rearing to a much later date than normally. The cold and drought reduced the amount of bloom of spring plants to a minimum. Native shrubs, including the mesquite, made a very poor and scattering bloom which gave the bees sufficient stores to raise a very much belated field force and to store some little amounts of honey. Horsemint which generally gives the bulk of the spring crop at this place was absent. The mesquite flow due to low temperature continued in a very meager way until the middle of May when the honey flow ceased althogether. During the last week of May a sufficient amount of rainfall occurred to make up for the deficiency during the preceding four months. The manner of falling was such that the majority of this water ran off and did not benefit the honey plants to any great extent. The summer was normal for heat but immediately following the heavy rain of May a drought set in and lasted throughout the summer and fall. Stimulated by the heavy rain in May a light honey flow occurred from mesquite, white brush, and belated annuals through July. Likewise the temperatures were belated and the active period of the bees was carried through what is commonly the quiescent period of July and August. Late in September the bees began fall brood rearing and were able to store from broom weed and kindred composites a sufficient amount of nectar to go through the winter. With the coming of December the drought was ended by a series of rainfalls which, by the end of the year, brought the rainfall to nearly normal. The following definite responses of the bees to adverse conditions were noted. Brood rearing was deferred for over a month awaiting the proper temperatures. The amount of brood produced was below normal because of the lack of new pollen and nectar in the field. The summer quiescence was deferred on account of low temperatures and the presence of nectar in the field. The fall brood rearing likewise was deferred because of the lack of honey plants in bloom. The winter quiescence began very early because of an early arrival at the mean temperatures which cause clustering and of the presence of cloudy weather.

H. B. Parks.

Adaptability of Native Plants

The rapid increase in the interest in native plants which can be utilized for yard, farm, and roadside ornamentation has necessitated an increased study of honey plants which are adapted for these purposes. The observations obtained on the general growing of native and introduced plants up to this date warrant the following statements. The temperatures which govern plant existence are the extremes which occur at abnormal times. The limiting factor in the growing of introduced plants is a late freeze which occurs after the newly introduced plant has responded to the abnormally warm periods which occur before the period of no frost. Plants that have lived through low temperatures successfully for a number of years under the stress of a very warm day put on a large amount of new growth and even attempt to bloom. When a norther comes, the plant will be frozen to such an extent that the organism is killed. Native plants seldom respond to these periods of heat. Light, rather than heat, is a limiting factor in many of the introduced plants and seedlings of native plants. The most common cause of death among introduced species is the hours of intense sunlight through July and August. Plants grown under shade and plants grown in the open were tested. The temperatures in the open and under the half shade were identical, yet the plants in the open died. This is so true of the seedlings and of introduced plants that an artificial shade should be utilized for the growing of seedlings, be they annuals, perennials, shrubs, or trees. A majority of deaths of fruit trees, ornamentals, and perennial forbs occur in the fall of the year. This is due to heat and drought. Evaporation causes the dirt to bake around the roots of the tree until the root system as well as the branches have ceased to function long before it is noticed that the tree is dying. A comparison of the records shows there is a connection between the rainfall in October and November and the fruit crop of the following summer. If the fall weather is extremely dry, the chances of a fruit crop are small.

Melilotus alba var. annua (White Sweet Clover). The commercial hubam is an annual and has been grown on this Station for twelve years. Careful tests show that this variety here is superior to the biennial sweet clover. Measurements of the root system made of varieties show no difference in the size of the roots or extent of the root system. The annual clover was superior to the biennial in that the biennial blooms in midsummer, when nectar production is curtailed by heat. Yellow sweet clover, which is being exploited, has been tried here for ten years and does not thrive on the Eocene soils of the Gulf Coast.

Rumex hymenosepalus (Canaigre). A revived interest in ths plant was brought about by a search instigated late in 1936 for an early pollen producing plant for bees and by the interest that has been taken in this species as a source of tannin. Canaigre has been grown at this place since 1922. It was found that any beekeeper who has a lack of pollen plants in his location would do well to plant a few tubers of canaigre in sandy locations within reach of his bees, as this plant from the middle of January to the middle of July will produce flowers and a copious supply of pollen, which is gathered by the bees and evidently utilized by them. The findings of the Laboratory relative to canaigre were issued in a mimeographed progress report. This report may be summarized by saying that in sandy locations in southern Texas canaigre will produce approximately the same amount of tubers as sweet potatoes will at the same location. Canaigre takes advantage of the cold and generally abundant rainfall of the midwinter, its large growth being made in January and February; however, the tubers do not reach maturity until the middle of July. The plant to become a staple crop in this section must have a demand.

Rhus virens (Evergreen Sumac). This is a most beautiful evergreen shrub, native to the Edwards Plateau and the mountains of the Trans-Pecos Texas. This shrub has been grown here from seed and from transplanted individuals. It is grown in cultivation in the city of Dallas. This would indicate that temperatures are not a limiting factor in its distribution. It is native to limestone hills and is susceptible to root rot. It is of quite rapid growth and where grown as an ornamental should be pruned. *Rhus virens* blooms in September and October. The flowers are white and borne in small clusters. These are followed by scarlet berries covered with wool. The plant is very acceptable to bees. Many beekeepers move their colonies to locations on the Edwards Plateau to pick up the fall honey flow from this sumac after all chance of a honey flow has disappeared on the Gulf Coast.

Rhus copallina (Dwarf Sumac). This is a tree-like sumac of the black-land district of Texas and is also found throughout the eastern half of the state. It grows to the height of six to ten feet and produces numerous clusters of small yellow flowers during July and August. These are followed by light red fruits which are covered with wool. As this plant is very common in the black land section where cotton is the major honey plant, it is of great aid to the beekeeper, as nectar from it furnishes a goodly addition to that which comes from cotton. Honey from this plant alone is of good quality. *Rhus copallina* can be distinguished from the other species of sumac, as the leaflets have a leaflike projection which ties them together and to the midrib.

Rhus lanceolata (Plateau Sumac). This is the plant similar to *Rhus copallina* but is restricted to the limestone hills of the Edwards Plateau. The leaves of the plant are not so wide and are longer. The leaflike wings between the leaves are much narrower and the plant grows more as a bush than *R. copallina*. This plant also produces numerous flowers which are eagerly worked by the bees.

Rhus microphylla (Shawnee-Haw). This shrub is found in small numbers over most of the state. In the brush country toward the Rio Grande River, it is a conspicuous member of the Brush Association. The plant grows as a low shrub and with long flexible, red-brown branches which are inclined to droop and ofttimes to root at the tips. It is the first shrub to bloom in the brush country. The white flowers are borne in dense clusters. The pollen and nectar from this plant produce the early and heavy brood rearing which is necessary to take care of the guajilla-catsclaw-mesquite honey flow which occurs shortly after the Shawnee-Haw blooms. The flowers are followed by clusters of light red woolly fruits, which are quite ornamental. The small pinnately divided leaves make this plant one desirable for roadside and yard ornament.

Rhus glabra (Smooth Sumac). This is the tall growing sumac of East Texas. Because of its large pinnate leaves, silver on the underside, light green above, which turn a brilliant scarlet in the fall of the year, and its huge clusters of red fruits which stay intact during the most of the winter, this plant is a very desirable ornamental. It is a good bee plant, and wherever it occurs in quantity is of value. Trials made here would indicate that *Rhus glabra* needs a greater rainfall than that which exists in the central and western part of the state.

All plants belonging to the family *Anacardiaceae*, which include *Cotinus* the native smoke tree; *Pistacia*, a very rare tree which occurs only in one location in Texas; and numerous Rhuses, which include the sumac and poison ivies, are visited abundantly by honeybees, and likewise all of them are good ornamentals. All species of this family are under observations here.

Tung Oil Tree. Because of the fact that the tung oil tree is a beautiful ornamental and also is probably of value as a honey plant, a trial was made at this Station. Twenty individuals started from seed made abundant growth through three years, after which time it seemed necessary to transfer them from the nursery row to a permanent location. These trees were properly balled and transplanted in February of this year. They gave every indication of having recovered from the transplanting. By the first of June all of them had died, evidently from drought. There was no indication whatever of root rot.

During the year 1936 Dr. L. H. Bailey of Cornell University insisted that, on account of the value of the genus *Rubus* for honey production, and because of the lack of knowledge of that genus in the State of Texas, this Laboratory should begin an investigation of the value of these plants. To that end numerous species were collected in the field and plants for growing were procured. The collection of *Rubus velox* Bailey and *R. mississippianus* Bailey in the hills north of San Antonio led Dr. Bailey to suggest this work, as both species are supposed to be the native species from which many cultivated forms have arisen, and until our collection of these, their original habitat was unknown. In addition to these species a red flowered dewberry and a very pecliar blackberry have been secured from the sand hill region south and east of San Antonio.

The results obtained in the study of the adaptability of native plants were brought together and were published as Bulletin 551 "Valuable Plants Native to Texas."

H. B. Parks, A. H. Alex.

Queen Rearing

The strain of bees which has been developed at the Laboratory during the past fourteen years was carried through another set of life cycles during fall and summer periods. A sufficient number of queens were produced to requeen the colonies at the Laboratory. Intensive work on this project has given way to the work on the cooperative project of breeding of queens en masse with a view to the bringing into existence of a strain of bees which are either resistant or immune to American Foulbrood. The Laboratory strain will be maintained until such a time as accurate measurements of the individuals produced and of those which have been preserved at periods during the life of this project can be compared.

A. H. Alex, H. B. Parks.

Breeding for Resistance to American Foulbrood

(In cooperation with Bureau of Entomology and Plant Quarantine, U. S. D. A.)

The beekeeping industry throughout the United States is restricted to its present static condition by three factors: first, the continuing reduction of natural bee pasturage; second, the widespread distribution of the contagious disease, American Foulbrood; and third, the handicap of a disorganized marketing condition. Individuals, private organizations, and both State and Federal Experiment Stations have studied this disease through a period of more than thirty years, yet, at the present time, there is no satisfactory control for the disease. About twenty-five years ago observations indicated that certain colonies of bees evidently were resistant to brood disease, and it was proposed to select breeding stock from such colonies. Because of circumstances these plans were not carried out. Several years ago this plan was again brought to the attention of beekeepers, and in 1937 a cooperative project under the leadership of the Bureau of Entomology and Plant Quarantine was established. Several states, including Texas, were brought into this work. This Laboratory was named as the headquarters for the work done in Texas, and the part of Texas in this project is the breeding of queens of known parentage in large quantities. These queens are supplied to other cooperators in other states where under careful supervision, these queens are tested for the disease resistance of the colonies which they head. During the year 1937 four queen yards and one cell yard were established. Nine hundred sixty-five queens were reared and placed in the hands of the other cooperators or used to maintain the cell colonies and nucleus supply. It is proposed that this project be carried on with a constantly increasing production if the findings of the first two years indicate that the bees produced are really resistant to disease.

H. B. Parks, A. H. Alex.

Bee Production

The activity of the honeybee gave some very decided information as to the relationship of honey production and queen rearing. The Laboratory yard, which has been maintained very largely for honey production, was used as a cell building yard for the cooperative project. As a result there was no honey stored over and above that needed by the bees for cell building and for winter stores. Two colonies were maintained to ascertain the probable yield of the yard. These colonies produced forty-two pounds each, which is taken as a fair average of the amount the remainder of the yard should have produced. The nectar yield was very meager; however, it requires a large number of bees and honey to rear the number of cells needed in such a project as the cooperative one. It is estimated that five thousand cells were utilized in the rearing of 965 queens. This large number came from the fact that prolonged cold and cloudy weather made cell building very difficult and that the distance to which the cells were carried before introduction ofttimes necessitated several hours of exposure to below normal temperature.

A. H. Alex, H. B. Parks.

Horsemint for Honey and Oil Production

The trips taken during the spring of 1937 added much to a knowledge of the distribution and species of horsemint of Texas. It was found that because of misidentifications the early blooming horsemints of the Red River Valley were not the same as the plants going by the same name which occur in central Texas. These observations very materially change the interpretation of the horsemint distribution throughout the state. It has long been known that in the genus *Monarda* the species can be divided into two groups according to the properties of the oil which they contain. Much additional information was secured during the year of 1937 by the publication of the results of the distillation of Texas horsemint by C. C. Albers, University of Wisconsin. This Laboratory furnished most of the horsemint upon which he worked.

H. B. Parks, V. L. Cory.

Relationship of Honey Plants to Insects

From the standpoint of the ecologist the honeybee must be looked upon as an intruder upon the rights of the native insects. From the standpoint of the beekeeper, native insects are intruders upon the rights of the honeybees. In the observations which have been conducted here it was found that in optimum years for nectar production there is little or no competition, as the native insects are largely oliogotropic or inclined that way, while the honeybee utilizes whatever plant is the most easily available. During the years in which there is a lack of nectar flow, the native insects are also present in smaller quantities because of the fact that their numbers are governed by the same factors which govern the amount of blooming plants. The honeybee is not so governed, as its population is kept intact by man. With the return of a series of normal years, the plants regain their normal condition and normal nectar secretion. Then the native insects can again reach their normal population. It was observed during the past three years that, though the plants were constantly approaching normal and the native insect population was still much below normal, the honeybees remained normal. In 1937, during which time the weather was adverse to all insect life, there were few native insects flying during the spring of the year. During the early summer only a few of the common ones could be observed but because of the rains in October and November native bees which generally fly in May and June were observed collecting nectar and exhibiting every indication of breeding.

H. B. Parks.

Plant Survey of Texas

The plant survey of the State of Texas, which began with private records in 1912 and 1917 and took the form of a project in 1934, reached its culmination in Bulletin 550 entitled "A Catalogue of the Flora of Texas." This bulletin contains approximately 5300 forms. On account of the constantly increasing interest in plants by the people of the state, new species are constantly coming to the attention of the authors and new distribution records are extremely numerous. It is now estimated that the actual number of species now living within the state is near to 5500. It is to be said that a considerable number of these additions are of new weeds and escaped cultivated plants.

H. B. Parks, V. L. Cory.

Miscellaneous

During the year some additional aid was given the Big Thicket Association of East Texas in the completion of the manuscript "The Flora and Fauna of the Big Thicket" and in the reading of proof upon the same. Two thousand copies of this were printed and distributed.

The Texas Beekeepers Association held its annual meeting at Uvalde July 16-17. This meeting was attended by 250 beekeepers who actually operate commercial apiaries. It is to be said that the Annual Report of the Secretary of this organization consists of two hundred pages, containing a very complete history of beekeeping operations in the State of Texas during the current year and a considerable amount of the previous history of beekeeping in this state which is included in the annual reports as this material can be secured. This series of reports, which now consists of eight large volumes, contains a most complete history of beekeeping in this state and in addition much of the history of the beginning of beekeeping in the New West.

Because of the intense interest of the Home Demonstration Clubs in the use of native plants for ornamentals, considerable time has been given to the identification of plants for these organizations. Three schools were held for individual counties and instruction given not only as to plants and their uses but as to the best ways of securing such plants. A school for County Home Demonstration Agents was held in October. This was largely attended and quite an elaborate program was mimeographed and used as a field book during the meet. The State Highway Department horticulturists have brought and sent in more than one thousand plants for identification.

AGRICULTURAL ENGINEERING

Mechanical Harvesting of Cotton

This marks the tenth year of the study of the mechanical harvesting of cotton, which also includes a study of factors of efficiency of mechanical strippers, extracting equipment, and the relation of varietal characteristics as they affect mechanical harvesting of cotton.

Changes have been made in both the Texas Station Harvester and the Extractor from time to time to improve the efficiency of these machines. Changes in the stripper for 1937 include smaller stripping rolls with the front bearing moved to the end of the rolls. The pickup finger mountings were changed so that both sides were movable and under spring tension. Expanding metal placed in the bottom of the conveyor troughs permitted screening a larger percentage of the trash out of the cotton as it was conveyed to the extractor.

Changes in the extractor consisted of making the lower fingers which extended under the reclaiming saw longer and out of larger wire. A 2-inch stiff-bristled brush was installed at the end of these fingers to cause loose locks of cotton to be impinged upon the reclaiming teeth.

In harvesting seven varieties of cotton at College Station on August 27, the machine harvested an average of 97 per cent of the cotton on the plants. The extractor lost an average of 4.7 per cent of the cotton that was harvested by the stripper. The extractor removed all the burs and green bolls without crushing them and a high percentage of the green leaves that were removed from the plants in the harvesting process. There were just enough green leaves left in the cotton to require drying it for about a half day before carrying it to the gin.

At Lubbock in harvesting thirteen varieties of cotton yielding an average of a bale to the acre, on November 6 an average of 98.8 per cent of the cotton on the plants was removed by the stripper. The extractor did an excellent job of removing the burs, green bolls, and green leaves from the cotton.

A sample of cotton from each of the varieties harvested by the stripper at College Station and Lubbock was harvested by hand to determine the difference in grade in hand-picked and machine-harvested cotton. At College Station two of the hand-picked samples classed middling, four bright middling, and one strict middling. For the machine-stripped cotton one sample classed bright middling, one strict low middling, four bright strict low middling, and one low middling. The stripped cotton classed approximately one grade lower than hand-picked cotton. At Lubbock hand-picked cotton classed good middling for seven varieties and strict middling for six varieties. Hand-snapped cotton was slightly lower with six varieties running strict middling, two middling, and five bright middling. Of the varieties harvested with the Texas Station Cotton Stripper six classed middling, one strict low middling, five bright strict low middling, and one strict middling. Hand-snapped cotton, therefore, averaged less than one grade lower than hand-picked cotton, and machine-stripped cotton averaged about one and one-half grades lower than hand-picked cotton. Stripped cotton averaged approximately one-half grade lower than hand-snapped cotton.

Machine-stripped cotton ginned on a commercial gin, equipped with boll-extracting and cleaning machinery, classed good ordinary, or an average of three and one-half grades lower than stripped cotton which was run through the Texas Station Vertical Cleaner. The gin was equipped with an airline cleaner.

The breeding work to develop types of cotton better suited to mechanical harvesting than the commonly grown varieties was continued both at College Station and Lubbock. At College Station twenty-one special inbred selections of Ducona and several hybrid strains were harvested with the machine to test the effects of plant and boll characteristics on the harvesting qualities. The cotton harvested at Lubbock was of the varieties and strains being developed at the station which appeared to have excellent characteristics suitable for mechanical harvesting. Additional information on the breeding work will be found in the report of the Division of Agronomy.

Snapping qualities of cotton bolls: In connection with the mechanical harvesting of cotton an extensive study was made this year of the snapping qualities of cotton bolls from twenty varieties at College Station and thirteen varieties at Lubbock. Results of these studies indicated that varietal characteristics have considerable influence on the snapping qualities of cotton bolls. It appears that bolls are harder to pull off varieties having short fruiting branches and bearing the bolls in clusters than they are from varieties which have long fruiting branches bearing the bolls singly. Weather and the growth conditions of the plant affected the snapping qualities more than did the length and diameter of the peduncle.

H. P. Smith, D. T. Killough, and D. L. Jones.

Fertilizer Placement and Soil Disturbance Studies

The 1937 fertilizer placement and soil disturbance studies on cotton at College Station and Nacogdoches were repetitions of the experiments conducted in 1936.

At both locations the placement one inch under the seed delayed germination and resulted in fewer seedlings than did the check with the same soil disturbance but no fertilizer. Placing the fertilizer two inches under the seed gave a greater number of seedlings at Nacogdoches but a slightly smaller number at College Station than did the check. Fertilizer placed three inches under the seed gave a greater increase in the number of seedlings than did the check. These results are reflected in the percentage of germination on seedlings that emerged.

At College Station the results for the side placements were slightly in favor of the checks, except for the one inch depth, which produced significantly more seedlings than were obtained for the check. All of the placements to each side gave more seedlings than did the checks. There was, however, only a slight difference in favor of the one-side fertilized test over the check.

The averages for both locations indicate that where the fertilizer is placed far enough from the seed to prevent injury it has a stimulating effect and more seedlings emerge than on rows having the same soil disturbance but no fertilizer.

In all the tests significantly higher yields were obtained on the fertilized rows than on the checks. At both locations the lowest yield for the fertilized rows was where the fertilizer was placed one inch under the seed. Generally higher average yields were obtained for the side placements than for the placements under the seed.

Treatment of Cottonseed for Planting Purposes

The work started in 1936 to compare the effects of Ceresan, lime, and sulphur on the germination of sulphuric acid delinted and undelinted seed was continued both at College Station and Nacogdoches this year.

Results at College Station showed that fuzzy seed treated with Ceresan gave a larger number of seedlings than when treated with sulphur or lime. Fuzzy seed treated with lime gave fewer seedlings than did any of the other treatments. No significant differences were found in the number of seedlings obtained when delinted seed were treated with Ceresan, sulphur, or lime.

Results at Nacogdoches showed significant increases in the number of seedlings when fuzzy seed treated with Ceresan were compared with seed not treated. Neither sulphur nor lime gave as good results as did Ceresan. Only a slight increase in the number of seedlings was obtained when acid delinted seed were treated with Ceresan, as compared with untreated delinted seed. Treating acid delinted seed with lime or sulphur appeared to reduce slightly the number of seedlings obtained when compared to untreated delinted seed.

Planting of Cottonseed at Variable and Uniform Depths

Results obtained for a period of six years did not show any significant differences in the yields when cottonseed were planted at variable and uniform depths. For this reason this test was discontinued in 1937.

Use of the rubber press wheel: The test started in 1936 at College Station and Lubbock to determine the effects of a small rubber-tired press wheel attached to the planter at a point where the wheel would roll and press the seed in the bottom of the furrow before they were covered was conducted at both these places in 1937.

Results at College Station showed that the use of the rubber-tired press wheel gave more rapid germination and a greater total number of plants than were secured on rows where the press wheel was not used. Results at Lubbock will be found in the report of Substation No. 8.

Width of furrow openers: Better stands were obtained when a narrow seed furrow opener was used than where a wide furrow opener was used. Higher yields were also obtained where the narrow furrow opener was used.

H. P. Smith.

Atmospheric Exposure Tests of Wire and Fencing

A study on the atmospheric exposure of wire and wire fencing is conducted in cooperation with the American Society for Testing Materials. An inspection in October showed that the uncoated specimens were covered with rust. The light coats of galvanized wire were showing the effects of weathering more than the heavier coats. Samples of stainless steel wire were speckled but did not have any deep rusty pits. Copper wire did not show any effects of corrosion but there was a sprinkling of yellow spots on the lead-coated wire. The inspection showed that weathering appeared to affect the south and west sides of the vertical stays more rapidly than it did those on the north and east sides.

H. P. Smith.

Eradication of Prickly Pear

During the four years of experimental work on the eradication of prickly pear it was found that the most effective of all poisons tried consisted of 3 pounds of arsenic pentoxide to 1 gallon of water, to which was added 1 pint of commercial strength sulphuric acid. Tests indicate that a metal alloy of 18 per cent chromium, 8 per cent nickel, and not over 0.07 per cent carbon, generally termed 18-8-S stainless steel, will resist the action of the pear poison sufficiently to be used as sprayer or atomizer tanks. A tank constructed of 18-8-S stainless steel, after several months exposure to the pear poison, shows no, or little, corrosion.

W. H. Dameron and H. P. Smith.

Garlic Drying

The garlic experiments conducted jointly by the Division of Agricultural Engineering and the Division of Plant Pathology and Physiology, which were started in 1936, were continued this year.

It was found in 1936 that the angle of the racks in the drier made it necessary to pile the garlic thickly on the racks and this prevented the free flow of air through and around the bulbs. The bulbs were also bruised when dropped from one rack to another. This year these racks were torn out and chains with lugs about every four inches were placed in each of the four corners of the drier, so that trays could be placed on the lugs at the top and lowered as needed until the garlic was dry, after which they were removed through a door at the bottom of the drier chute. A total of forty trays, each having a capacity of about 30 pounds, or a total of 1,200 pounds of green garlic, could be placed in the drier at one time. Approximately 2,500 pounds of garlic were dried for periods ranging from thirteen to twenty hours at a temperature of approximately 120° F. Garlic dried for this length of time lost on an average 12.90 per cent moisture. When the dried garlic was placed in storage and left for three months, there was an additional loss of 25 per cent. Garlic dried and placed in storage did not decay during the storage period.

Tests were made on harvesting garlic by running a U-shaped blade under the plants to loosen the soil around the bulbs but not exposing them to the sun. The bulbs were left in the loose soil for one week, during which time the tops had dried out, making it possible to dry the bulbs in less time than garlic freshly uprooted. Some garlic was dried in the shade successfully by placing it on trays which were elevated approximately three inches above the ground, so that the air could circulate under, above, and around the bulbs. Frequently garlic exposed to hot sunshine is injured by sun blisters.

Results of the experimental work on the control of diseases by treatment of the seed before planting and by drying will be found in the report of the Division of Plant Pathology and Physiology.

H. P. Smith and G. E. Alstatt.

WILDLIFE RESEARCH

(In cooperation with School of Agriculture and School of Arts and Sciences, Agricultural and Mechanical College of Texas; the Texas Extension Service; the Bureau of Biological Survey, U. S. Department of Agriculture; the American Wildlife Institute; and the State Game, Fish and Oyster Commission)

Walker County, Texas, Wildlife Resources Survey

A quail census of 8,949 acres, or 1.72% of the county, resulted in an estimated population of 40,255 quail for Walker county. The census also showed that sandy land farms and pastures average one covey to 78.6 acres; blackland farms and pastures one covey to 116.2 acres. Cut-over pine woodland is at its best for quail when it is five to nine years old, at which period it contains one covey to 78.7 acres. The average covey size on December 1 was 11.25 birds on grazed and hunted areas; 16.8 birds on ungrazed and protected areas. Winter loss of birds from late November to early February was 56 per cent on the blacklands and 32 per cent on pine woodlands. Dogs and cats are undoubtedly an important factor in the wildlife equation. Walker county averages one dog to 117 acres, one cat to 122 acres. Seventy-nine bird dog owners in the county hunted an average of 11.5 times during the six weeks season and killed an average of 82 birds apiece.

Fox hunting and conservation of deer appear to be mutually exclusive. It is estimated that the elimination of fox hounds and protection of existing stocks could result in building up the deer population to approximately 6,000. Tenantry and overgrazing were found to be the two most important agricultural institutions affecting wildlife in the county. Both tend to render conditions less favorable for wildlife.

Daniel W. Lay and Walter P. Taylor.

Bobwhite Quail in East Texas; Field Studies

Records from 21 nests indicate that in East Texas reptiles may be an important factor in limiting quail increase.

In studies of coveys and their ranges, individual birds were flushed as date as October 8, although coveys were noted as early as September 15. One covey found on September 16 comprised more than one brood, for it contained grown young quail as well as quail about one-third grown.

Studies of the sex ratio in quail showed 58 males and 64 females in a population of 132 birds trapped from 17 coveys totalling 246 quail. Since both quail subspecies, *Colinus virginianus virginianus* and *Colinus virginianus texanus*, as well as hybrids between these were involved, there is no indication that the sex ratio has been disturbed by hybridization. The data at hand suggest widespread and gradual intergradation between the two subspecies, both in Washington and Walker counties. Efforts to test the effects of hybridization under controlled conditions were unsuccessful. Excellent hatches were obtained but none of the young quail survived.

Experiments on plowing pastures at College Station indicate that the pasture is improved through the reduction of needlegrass and an increase in Bermuda, while food and cover for quail are improved by an increase in goat weeds, ragweed, and other quail foods. Improvement in pastures, however, is largely dependent upon precipitation soon after plowing.

A bulletin by Lehman, "Increase Quail by Improving Their Habitat," was published during the year. This bulletin emphasizes the necessity of adequate food and cover, in the absence of which, legal restrictions, predator control, and establishment of sanctuaries have but little effect.

Valgene Lehmann, D. H. Reid, Henry Hahn, Hilbert R. Siegler.

Plant-Wildlife Relationships

(In cooperation with Sam Houston State Teachers College, Huntsville)

A study of the plant succession that follows logging in Walker county shows four distinct stages. In the first period, one to four years after logging, pine seedlings, hardwood sprouts, and some weeds predominate.

Five to nine years after logging, the short grasses, Bermuda and carpet, tend to form a sod. The legumes are most prolific during this period and some weeds, such as doveweed, are present. In the third stage, ten to fourteen years after logging, the tall grasses, broom-sedge and needle grass, form a "rough" in the open spots, the brush thickens and pine seedlings form many dense stands. In the fourth stage, which includes all areas cut more than fourteen years, the pines over-top the second growth hardwood and very little herbaceous vegetation is found. A quail census on 4,875 acres of cut-over land shows one covey to 158.3 acres in the 1-4 year stage, one covey to 78.7 acres in the 5-9 year stage, one covey to 95.0 acres in the 10-14 year stage, and one covey to 546.0 acres in second-growth woodlands 15 years old or more.

It is concluded that management of quail in second-growth pine woodland should strive to maintain the conditions of the five to nine year cut-over stage. This may be done through judicious use of fire, strip plowing, and brush cutting to keep the brush open and legumes and weeds in proper balance with grasses.

S. R. Warner and Daniel W. Lay.

The Gray Squirrels and Fox Squirrels of East Texas

A study of the food habits of squirrels through an examination of the stomach contents of 240 gray squirrels and 112 fox squirrels showed that while nuts and acorns are the preferred foods of both species, a variety of plants are also eaten, including herbs, shrubs, grasses, weeds, trees, and vines. Even insects (Lepidoptera and Coleoptera) are eaten.

The gray squirrel was found to prefer moist mesophytic vegetation with the pin oaks *(Quercus phellos* and *Q. niger)* as the key species. The fox squirrel prefers dryer, more open types of woods with the post oak *(Quercus stellata)* and red oak *(Q. rubra)* as the key species.

A comparison of hunted and protected land showed one gray squirrel per acre on the former, two on the latter. Hunting seems to favor the fox squirrel at the expense of the gray squirrel. Over-harvesting of timber, overgrazing, and severe hunting are all factors contributing to the reduction of the squirrel population in East Texas.

Phil D. Goodrum.

Ecology of the Attwater Prairie Chicken.

The very existence of this species is threatened by a combination of forces which are difficult to control. Formerly occupying a large region from southwestern Louisiana into South Texas, it is now limited to an area on the coastal prairie of Texas. An estimate of the prairie chicken population on 100,000 acres of three of the best counties indicates a total population of 380 birds in this area, of which 45, or 13 per cent, were taken during the legal open season. The principal causes of mortality appear to be: (1) Deficient cover caused by heavy grazing and burning; (2) concentration of adults in short grass areas for mating rituals; (3) large numbers of hawks in early spring; (4) loss of young in floods, resulting from nesting in damp depressions bordering ponds, a consequence, in turn, of shortage of cover resulting from overgrazing and burning.

Valgene Lehmann.

Present Status and Future Needs of Vanishing Species

Through questionnaires, interviews, and field observations a beginning has been made in an inventory of Texas' vanishing species. Those principally concerned include certain species of big game, flesh-eaters, furbearers, hawks, game birds, and waterfowl. While a number of creatures are so much reduced that they might even become extinct, with few exceptions the trend with all species, of game at least, is downward. The most outstanding exceptions are the white-tailed deer and the wild turkey of the Edwards Plateau and south Texas. These, carefully protected by interested landowners, are holding their own or even increasing. Some work has been done on the following species: (1) *Big Game*, pronghorned antelope, peccary, Texas bighorn; (2) *flesh-eaters*, ocelot, black-footed ferret, eyra cat, coati-mundi, Mississippi Valley wolf, Louisiana bear, otter; (3) *Fur-bearers*, Texas beaver, broad-tailed beaver; (4) *Hawks*, white-tailed kite, Mississippi kite, Sennett white-tailed hawk, Aplomado falcon, Mexican black hawk; (5) *Game Birds*, black-bellied tree duck, white-winged dove, chachalaca, red-billed pigeon, white-fronted dove. All these species should be given further detailed attention, their life histories worked out, and the practical conditions determined for their conservation.

Walter P. Taylor.

FEED CONTROL SERVICE

Inspection

The usual systematic inspection of feeding stuffs has been maintained during the past year and seven inspectors have visited feed manufacturers, feed dealers, and a considerable number of consumers in order to secure official samples for analysis, weigh packages to prevent selling short-weights, and detect other possible violations of the provisions of the Texas feed law. Each inspector files at the office each week an itinerary which is subject to revision if considered advisable. In addition he is required to submit a daily report of his activities. During the period covered by this report the inspectors have traveled 100,885 miles in the performance of their official duties and visited 18,250 firms in 4,111 towns and cities. Several trips were made from the office for the purpose of carrying on special investigations.

Computed from the sale of feed inspection tags, there were 1,443,552 tons of feed sold in the State during the year ended August 31, 1937, as against 1,210,790 tons the previous year, and an average of 1,047,542 tons for the past twenty years. This tonnage does not include hay, straw, and whole or unground grains or seeds, but only the amount of feeding stuffs regulated by the Texas feed law. Cooperation with the Food and Drug Administration of the U. S. Department of Agriculture has been continued and thus control exercised over interstate shipments of feed as further protection to Texas purchasers.

Samples

During the fiscal year the inspectors secured 3,473 official samples of feed, which were subjected to chemical analysis and microscopic examination. In addition to these, there were analyzed a few registration and special samples, making a total of 3,555 samples analyzed during this period. Sixteen samples of vitamin D supplements were assayed for antirachitic potency, and seventeen samples of cottonseed cake were tested for hardness.

Reports

The results of inspections and analyses are reported to the manufacturer, dealer, and consumer as soon as practicable after the results are available. When a shipment appears to be adulterated or misbranded, the dealer is notified and advised to remove it from sale until the matter has been satisfactorily adjusted.

Shipments Withdrawn from Sale

During the year covered by this report dealers were advised to remove from sale 572 shipments of feed, manufactured by 331 different firms, totaling 1,469 tons. These shipments were removed from sale because they did not meet the requirements of the law. Untagged shipments were properly labeled with tags furnished by the manufacturers; improperly labeled shipments were relabeled with official tags properly printed, or with tags showing guaranties that could be maintained, and in still other cases shipments were returned to the manufacturer. The sales of goods below guaranties were adjusted, in practically all instances, by manufacturers paying refunds to dealers and consumers when the deficiencies were sufficient to warrant such action. In all cases where refunds were made to dealers, the dealers were advised to prorate the same to their customers, in so far as possible, so that the ultimate consumer would receive its benefit.

Violations

During the year six complaints were filed with County Attorneys against manufacturers violating certain provisions of the Texas feed law. Five of these cases were settled by payment of fines and docket costs and one case was dismissed on payment of fine and cost by the same defendant in another case. Five hundred and seventy-two minor complaints were adjusted through correspondence from the office together with the assistance of the inspectors. These complaints consisted of untagged shipments of feed; improperly labeled shipments; incorrectly printed tags attached to the packages of feed; short-weights; deficiencies in crude protein, and other minor irregularities.

Eleven firms were cited for hearings to be held in the office for the purpose of presenting evidence to show cause why they should not be prosecuted for violating the law. Seven of these firms sent representatives to the hearings and four answered the citations by letters. Upon presentation of the evidence such action was taken as seemed advisable.

Hardness of Cottonseed Cake

In view of the fact that complaints are frequently received by the Division of Feed Control Service that the cottonseed cake sold for feeding purposes is too hard for the animals to eat, it was considered advisable to continue the examination of some of the cake upon the market. Seventeen samples of cottonseed cake representing the output of seventeen oil mills were tested for hardness and the crushing strength varied from 307 pounds, soft, to 1,526 pounds, hard. None of the samples examined could be considered as representing very hard cake. This work will be continued during the coming year.

F. D. Fuller, James Sullivan.

PUBLICATIONS

The Division of Publications edited and received for distribution thirty bulletins and two circulars and the Director's Annual Report. One report of the Division of Soil Survey published and distributed by the Bureau of Chemistry and Soils was received and listed among the station publications. Notice was received of publications in various scientific journals of thirty-two technical papers prepared by members of the station staff. There were sixty-nine popular papers by the station staff published in the various current journals and newspapers.

Seventy-seven Progress Reports were prepared in this division and read over the Texas Quality Network, after which they were mimeographed and sent to the press and various agricultural workers, including the Extension Service workers and the Smith-Hughes vocational teaching staff.

Circular No. 79, prepared in this division, carries abstracts of bulletins 523 to 538, Circular 77-78, the Director's Annual Report, Soil Survey reports for four Texas counties, thirty-two scientific articles, and citations of thirty-nine popular articles appearing principally in Texas publications during the calendar year 1936, as well as a list of available publications. This is the Annual Abstract Circular and was published in an edition of 75,000 copies and was sent to all names on our mailing list. A total of 181,144 publications were distributed during the year, leaving on hand in the mailing room 856,361 copies for free distribution.

Following is a list of the soil survey report, technical papers and the number and title of the 30 bulletins and two circulars published from September 1, 1936, to August 31, 1937:

Soil Survey Report

Soil Survey of Cass County, Texas, February, 1937, by M. W. Beck, in charge, and Howard William Higbee, United States Department of Agriculture, and R. M. Marshall, Texas Agricultural Experiment Station.

Technical Papers

228. The Effect of Temperature and Time of Cooking on the Tenderness of Roasts; Sylvia Cover. Journal of Home Economics, 29 (No. 8):567, 1937.

339. Cotton Flea Hopper Control Tests Using the Latin Square Plat Arrangement and Analysis of Variance; J. C. Gaines. Journal of Economic Entomology, 1937, 30:119-125.

359. The Occurrence of Talinum in Texas; V. L. Cory. Madrono, Vol. 4 (No. 2), April, 1937.

364. Control of the Bean Leafhopper; S. W. Clark, Texas Farming and Citriculture, September, 1936.

365. Anaplasmosis in Cattle; H. Schmidt. Journal of the American Veterinary Medical Association, N. S. Vol. 43, (No. 6), pp. 723-736, 1937.

366. Trichomoniasis or Trichomonad Abortion in Cattle; H. Schmidt. Journal of the American Veterinary Medical Association, N. S. Vol. 43, (No. 5), pp. 608-618, 1937.

369. Tests of Insecticides for Cotton Boll Weevil and Bollworm Control Using the Latin Square Plat Arrangement and Analysis of Variance; J. C. Gaines. Journal of Economic Entomology, 30:785-790, 1937.

370. Comparisons of Three Methods for Determining the Breaking Strength of Cotton Fibers; Mary Anna Grimes. Textile Research, January, 1937. 7:145-148.

371. The Location of Pentosans in the Resin Glands of The Cotton Embryo; R. G. Reeves and J. O. Beasley. Journal of Agricultural Research, May, 1937, 51:935-944.

372. A Comparsion of Fleeces from B and C Type Rambouillet Ewes; J. M. Jones, Paul Homeyer, S. P. Davis, W. H. Dameron, and B. L. Warwick. The American Society of Animal Production, November, 1936.

373. Competition Between Cotton Varieties in Adjacent Rows; J. R. Quinby, D. T. Killough, and R. H. Stansel. Journal of American Society of Agronomy, April, 1937, 29:4:269-279.

375. Hybrid Vigor in Sorghum, R. E. Karper and J. R. Quinby. Journal of Heredity.

76. Curly Top of Spinach in Texas, J. J. Taubenhaus and George E. Altstatt. The Plant Disease Reporter, 21(1):2, January, 1937.

78. Seedlessness in Tomatoes, Leslie R. Hawthorn. Science, February, 1937. 85:199.

79. Report on Fertilizers, G. S. Fraps. Journal Association Official Agricultural Chemists, 1937. 20:227-31.

80. Basicity of Some Phosphates as Related to Nitrification, G. S. Fraps and A. J. Sterges. Journal American Society of Agronomy, 1937. 38:613-21.

81. New North American Muscoid Diptera, H. J. Reinhard. Bulletin of Brooklyn Entomolgy Society, April, 1937. Vol. 27 (No. 2), pp. 62-74.

82. Disease of Range Angora Goats, I. B. Boughton. Veterinary Medicine, April, 1937.

88. *Paratrioza cockerelli* (Sulc) on Tomatoes in Southwest Texas, M. J. Janes. Journal of Economic Entomolgy, Vol. 30, p. 379, April, 1937.

89. The Cotton Flea Hopper, an Ecological Problem, F. L. Thomas and W. L. Owen, Jr. Journal of Economic Entomology. December, 1937. Vol. 30 (No. 6), p. 848.

90. The Genus Zephyranthes in Texas, H. B. Parks and V. L. Cory. 1937 Yearbook of the Amaryllis Society of America.

91. Notes on the Incidence of Vegetable Leaf Diseases at the Lower Rio Grande Substation, Texas Agricultural Experiment Station, Weslaco, Texas, G. H. Godfrey. The Plant Disease Reporter, 21(9):170-172 May, 1937.

92. *Phymatotrichum silvicola* n. sp.: Its Structure and Development; J. J. Taubenhaus and G. M. Watkins. American Journal of Botany, 24:387 (No. 6) June, 1937.

93. Male Sterility in Sorghum: Its Possible Utilization in Production of Hybrid Seed, J. C. Stephens. Journal of the American Society of Agronomy. August, 1937. 29:8:690-696.

94. The Effect of Three-and Four Year Rotations on Cotton Root-Rot in the Central Texas Blacklands, C. H. Rogers. Journal American Society of Agronomy. Vol. 29, 668-680, 1937.

98. A Decay of Ornamental Cacti Caused by Aspergillus Alliaceus, J. J. Taubenhaus and G. E. Altstatt. Mycologia, 29(6):681-685, 1937.

00. Reorganization of Counties, H. C. Bradshaw. Journal of Farm Economics, 3:741-749, 1937.

404. Weight of Clothing Worn by Texas School Children, Jessie Whitacre. Journal Home Economics, 29 (No. 8) :573, 1937.

412. Effect of Fertilization on the Composition of a Lufkin Fine Sandy Loam and of Oats Grown on It; G. S. Fraps, J. F. Fudge, and E. B. Reynolds. Journal American Society of Agronomy. 29:990-6, 1937.

415. Some Problems in the Successful Operation of Cooperative Cotton Gins, W. E. Paulson. The Southwestern Social Science Quarterly, Vol. 18, (No. 1), June, 1937.

435. The Somatic Chromosome Complement of *Zephyranthes robusta*, Walter S. Flory. American Journal of Botany, December, 1937. 24:733.

437. The Effects of Partial Sterility on Fruit and Cane Development of Blackberry and Dewberry Varieties, H. F. Morris. Proceedings of the American Society for Horticultural Science, 1937.

Station Publications

Bulletin	Title	Author	No. pages	No. copies
526	Calibration of Cotton Planting Mechanisms	H. P. Smith, and M. H Byrom	32	6,000
527	A Rating of Plants with Reference to Their Relative Resistance or Susceptibility to Phymatotrichum Root Rot	J. J. Taubenhaus, and Walter N. Exekiel	52	12,000
528	The Quantities of Vitamin A Required by Growing Chicks	R. M. Sherwood. and G. S. Fraps	15	6,000
529	Commercial Fertilizers in 1935-36	G. S. Fraps. S. E. Asbury, and T. L. Ogier	51	7,000
530	Ground Versus Unground Grain for Lactating Dairy Cows	A. L. Darnell and O. C. Copeland	25	8,000
531	Chemical Dust Treatment of Cottonseed for Planting Purposes	H. P. Smith, D. L. Jones, D. T. Killough, and H. C. McNamara	24	6,000
532	Commercial Feeding Stuffs	F. D. Fuller and James Sullivan	194	8,500
533	Soils of Collin, Frio, Galveston, Midland, Potter and Van Zandt Counties and the Trans-Pecos Area	G. S. Fraps and J. F. Fudge	54	7,000
534	Factors Which May Affect the Hardness of Cottonseed Cake	G. S. Fraps, and C. D. Marrs	27	6,000
535	Tree Fruit Varieties in North Texas	L. E. Brooks	26	10,000
536	Utilization of Vitamin A by Dairy Cows	G. S. Fraps, O. C. Copeland and Ray Treichler and A. R. Kemmerer	26	6,000
537	Locoine, the Poisonous Principle of Loco Weed, Astragalus Earlei	G. S. Fraps, and E. C. Carlyle	18	6,000
538	The Effect of Exposure in the Field on Grade, Strength, and Color of Raw Cotton	Mary Anna Grimes	35	6,000
539	Small Grains and Rye Grass for Winter Pasture	R. H. Stansel, P. B. Dunkle and D. L. Jones	38	12,000
540	Possible Savings Through Changes in Local Government	H. C. Bradshaw and L. P. Gabbard	92	8,000

Station Publications—Continued

Bulletin	Title	Author	No. pages	No. copies
541	Factors Affecting the Amount of Puffing in Tomatoes	S. H. Yarnell, W. H. Friend and J. F. Wood	64	8,000
542	The Effect of Temperature and Time of Cooking on the Tenderness of Roasts	Sylvia Cover	61	6,000
543	Irrigation Requirements of Cotton and Grain Sorghum in the Wichita Valley of Texas	C. H. McDowell	32	7,000
544	A Description of the Agriculture and Type-of-Farming Areas in Texas	C. A. Bonnen and B. H. Thibodeaux	91	20,000
545	Relation of Soil Acidity to Cotton Root Rot	J. J. Taubenhaus, W. N. Ezekiel, and J. F. Fudge	39	6,000
546	Further Tests of Vegetable Varieties for the Winter Garden Region	Leslie R. Hawthorn	43	8,000
547	Fattening Beef Calves on Milo Grain Prepared in Different Ways	J. M. Jones, F. E. Keating, and J. H. Jones	32	6,000
548	Machine Placement of Fertilizer for Cotton	H. P. Smith, H. F. Morris, and M. H. Byrom	52	6,000
549	Chemical Composition of Soils of Texas	G. S. Fraps and J. F. Fudge	87	13,500
550	Catalogue of the Flora of Texas	V. L. Cory and H. B. Parks	130	6,000
551	Valuable Plants Native to Texas	H. B. Parks	173	8,000
552	Toxicity of Bitterweed for Sheep	I. B. Boughton and W. T. Hardy	15	6,000
553	Commercial Fertilizers in 1936-37	G. S. Fraps and T. L. Ogier	53	9,000
554	Lechuguilla (Agava Lecheguilla) Poisoning in Sheep, Goats, and Laboratory Animals	Frank P. Mathews	36	6,000
555	Commercial Feeding Stuffs	F. D. Fuller and James Sullivan	195	9,000
Circular				
79	Abstracts of Bulletins 523-538, Circulars 77-78, and Other Publications During 1936	A. D. Jackson	34	75,000
80	Statistics of Texas Agriculture	L. P. Gabbard and C. A. Bonnen	103	10,000
	Forty-Eighth Annual Report	A. B. Conner	294	8,000

A. D. Jackson.

SUBSTATION NO. 1, BEEVILLE

Substation No. 1, located in Bee County, five miles east of Beeville, serves the interior Black Prairie Region, a large area of dark colored, fertile soils lying in South Texas. Goliad and Victoria type soils predominate this region. An average annual rainfall of 31 inches is fairly well distributed throughout the year, with more of it coming in the winter and spring months. Mild temperatures with few frosts prevail, giving an average growing season of 288 days. All these factors combine to make this region admirably adapted to diversified farming with livestock as a base. The critical period for plant growth in this area is the hot and dry season coming in July, August, and September. Therefore, it seems advisable to turn more attention to the growing of crops during the winter and spring months when moisture is usually sufficient and temperatures more favorable for plant growth. With these facts in mind the station is turning more and more attention to the finding and developing of crops suitable for growing in this period.

The chief concern of this station is the development of a profitable land utilization and soil conservation program adapted to this large area. Its activities consist chiefly of testing, developing, growing, and curing of feed crops and grasses, and their utilization through beef cattle; and the testing, developing and growing of profitable cash crops with which to complete a balanced system of agriculture. Some attention is given to testing of trees and ornamentals for use in landscaping.

Feed Crops

Climatic conditions for 1937 were very unfavorable for crop production. Rainfall was approximately half of normal throughout the growing season. Late frosts delayed plant growth in the spring. These conditions, together with a deficient soil moisture at the beginning of the year, tended to reduce all crop yields.

Corn: Corn was almost a failure in a large part of this area. Moisture shortage and late frosts combined to give poor stands. Excessive dry weather continued throughout the growing season and made all corn yields very low. Twenty-two varieties were included in a corn variety test. Yellow Surcropper gave the highest yields, 15.2 bushels per acre. White Surcropper came second with 14.2 bushels and was followed in order by Red June, Mexican June, Golden Thomas, Reece's Drought Resister, Ferguson's Yellow Dent, and White Thomas.

Surcropper, Thomas and Nicholson's Giant Yellow varieties were planted in a date of planting test February 20, March 1, March 15, and April 1. Surcropper and Giant Yellow gave highest yields on March 1 planting, while Thomas gave highest yield on February 20 planting. A period of years' average still gives the optimum date of planting around March 10. However, there is little difference between the first three plantings. Poor yields continue to be had from the late planting.

In the corn breeding work, Golden Thomas, a yellow corn developed from White Thomas, was registered under the state seed law, and more than 75 acres were grown for state certification by select farmers. This corn continues to make a creditable showing and is rapidly taking its place as one of the popular varieties in South Texas. Testing Pure Line X Golden Thomas first year hybrids was continued, but no outstanding results were obtained.

Grain Sorghums: The shortage of moisture reduced all grain sorghum yields severely. Both grain and forage yields were reduced on the first cuttings and no second crop was secured on any tests. Twenty-two varieties were included in the grain sorghum variety test. Leoto sorgo gave the highest grain yield with 19.6 bushels per acre. Texas Blackhul kafir came second with 18.1 bushels. These were followed in order by Hasselfield's Sumac, Schrock, Ajax, Kansas Wonder kafir, Darso, Black Amber sorgo, Reed kafir, Spur feterita, Grohoma, and Early Red kafir. African millet gave the highest yield of forage with 2.61 tons per acre. It was followed closely by Schrock kafir, Leoto sorgo, Reed kafir, Texas Blackhul kafir, Hasselfield's Sumac, Pink kafir, Grohoma, and Sugareck's sumac. When all characteristics are considered, Texas Blackhul kafir for early planting and hegari for late planting continue to give the best results. African millet, Leoto sorgo, and Schrock show promise as ensilage crops and are outstanding in resistance to attack of birds.

A grain sorghum date of planting and a grain sorghum rate of seeding test were planted but were abandoned because of poor stands caused by drought.

Small Grain: Twenty-one wheat and thirty-seven oat crosses and selections were planted in a small grain nursery to test their resistance to the rusts. Some selections continued to show remarkable resistance to leaf rust and some showed resistance to stem rust. Some of these strains continue to show promise as rust resistant strains for the Gulf Coast Prairie.

Increased plantings of broadcast Victoria oats showed complete resistance to leaf rust and in the face of a severe drought made a yield of ten bushels per acre, after having been grazed until late in March. These same oats planted in three foot rows at the rate of two bushels per acre gave a yield of twenty-one bushels of very heavy oats. They were cultivated twice. Harvesting was done with a row binder.

One acre of Bond oats resisted leaf rust and made a very heavy growth through the winter. They went down with stem rust in March and had to be cut for hay.

Winter Legumes: Nineteen varieties of winter legumes were included in a winter legume variety test. The highest yield came from Purple vetch with 1517 pounds of cured hay per acre. It was followed by Meliolotus indica with 803 pounds. Hubam clover gave 792 pounds, Canadian field peas 512 pounds, Hairy vetch 518 pounds, and Austrian winter peas 400 pounds per acre. No other varieties made sufficient growth to permit harvesting. Bacterial inoculation for nitrogen bacteria showed practically no increases n yield.

Summer Legumes: New Era cowpeas led the summer legume variety test with a yield of 1724 pounds of cured forage per acre. Sesbania came second with 1633 pounds and was followed closely by Chinese red cowpeas with 1620 pounds. Guar came fourth with 1567 pounds. Cowpeas continue to be the only promising summer legume for hay and for green manure. Lespedeza continued to make a complete failure. A nitrogen bacteria noculation test for cowpeas using single, double, and triple amounts of noculation, as recommended by the manufacturers, showed practically 25% increased yields over the non inoculated plats. It did not show an additional increase for higher amounts of inoculation.

A variety test of soybeans had to be abandoned because of the drought and jack rabbit injury.

Cash Crops

Cotton: A late March frost followed by an extremely dry season brought cotton yeilds far below normal in this entire area. The drought also caused a very poor staple.

Eighteen varieties were included in the cotton variety test. Qualla gave the highest yield with 211 pounds lint per acre. Lone Star placed second with 208 pounds. These were followed in order by Acala, Half and Half, Lone Star 5, Lankart, Kasch, New Boyken, Cliett, Mebane 804-50, and Sunshine. In a ten-year average Mebane 804-50 still leads the test with 358 pounds of lint cotton per acre. Oklahoma Triumph comes second with 306 pounds and is followed by Delfos with 302 pounds. In a seven-year summary Mebane 804-50 and Delfos led the field in average value per acre.

Mebane 804-50 and Lankart 40, varieties representing two of the leading types of cotton grown in this area, were included in a date of planting test. Beginning February 20, these varieties were planted at 10 day intervals up to April 1. The highest yield of Mebane 804-50 came from March 1 planting with 359 pounds lint per acre. This was followed by April 1, March 20, March 10, and February 20 plantings in the order named. Lankart, a late maturing variety, gave the highest yield, 312 pounds from the April 1 planting. It was followed in turn by March 20, February 20, March 1, and March 10 planting. In a three-year average both varieties have given the highest yields from the February 20 plantings. Yields have decreased as the planting dates advanced.

Breeding work with cotton, started in previous years, was continued. Additional Lankart strains were crossed on Mebane 804-50, and hybrids already on hand were back crossed on the parent strains in an effort to combine the good characteristics of the two varieties. Some of the hybrids were increased and tested. To date no outstanding results have been secured.

Broom Corn: Because of the very unfavorable weather little progress was made in the broom corn breeding work. Sufficient registered seed were grown to supply members of the South Texas State Certified Seed Growers with seed stock from which to grow State certified Texas Scarborough Dwarf Broom Corn seed. This variety which has been developed by the station is rapidly growing in popularity in this region.

The test to determine the hereditary effect of spikes in broom corn heads was run for the second time. Seed from spiked heads grown in 1936 produced 47.9% good heads. Those grown from center stem heads produced 35.6% good heads, while those from good heads produced 38.3% good heads. These results continue to indicate that spiking in broom corn heads is not altogether an inherited character.

Flax: A third test in growing flax as a winter crop was successfully completed. No cold injury was received during this test. A three-year average of the test indicates that flax can be profitably grown for seed, in this section, as a winter cash crop. Plans are made for a more extensive test in 1938. Interest is very keen in this project throughout the entire area.

Vegetables: Continued dry weather materially injured all winter vegetables and made it impossible to grow spring vegetables without irrigation.

Eight fertilizer and manure formulas were included in an onion fertilizer test. The highest yield of 13600 pounds of marketable onions per acre was secured from the treatment with 400 pounds of 6-12-0 fertilizer per acre. Next in line came 400 pounds of 6-12-6 fertilizer, giving a yield of 12575 pounds. The third was 400 pounds of 0-12-6 and was followed by 24000 pounds of manure. The check plat with no fertilizer gave a yield of 10450 pounds per acre. A four-year average indicates that 400 pounds of 6-12-0 or 400 pounds of 0-12-6 per acre might be profitable to use in onion culture. These gave an increase over the check plats of 22%.

The same formulas were used in a cabbage fertilizer test. All formulas gave a decided increase over the check plat. This increase ranged from 262% for the 1200 pounds of 6-12-6 per acre to 24.0% for 400 pounds of 6-0-6. Manure used at the rate of 12 tons per acre increased the yield by 192%. The large increase from the fertilizers apparently was due to the early maturity resulting from the treatment. Moisture was very scarce toward the end of the growing season and slow growing plats suffered severely. A two-year average of this test indicates that heavy applications of fertilizers to cabbage will be profitable.

Ten varieties of cabbage were grown in a variety test. Copenhagen Market gave the highest yields with 24,200 pounds per acre. Golden Acre came second with 23350 pounds. Midseason Market was third with 21,766 pounds. Late varieties made a complete failure because of the drought in the latter part of the growing season. Golden Acre probably gave the best marketable heads of the high producing varieties.

Fruit Trees and Ornamentals

All the citrus trees came through the 1936-37 season with little cold injury. Satsumas set an excellent crop of fruit, but dry weather retarded the growth. About 65 bushels were harvested from one acre. Meyer lemons bloomed early and most of the fruit was caught by the late frost. All other varieties were injured by the dry weather.

Chinese tallow trees, hackberry, huisache, and mesquite trees continue as the leading shade trees for this section. Tamarix, California privet, Amur River privet, and senisa continue to be used largely for hedge plants and for basal plantings. Other native shrubs, including Agarita, Guajilla, and senisa, continue to be used effectively in landscaping.

Beef Cattle

Because of the shortage of funds no beef cattle were carried during the first part of the year. An increased appropriation, by the Legislature, made possible the employment of an animal husbandman and the purchase of 300 acres of additional land and equipment to be used in an increased beef cattle program. The land has been purchased and is being conditioned for use in the enlarged program. Thirty-two head of yearling steers were placed in the feed lots in December. They are being used in determining the value of citrus pulp and of ground rice hulls. These cattle will be carried into 1938.

R. A. Hall.

SUBSTATION NO. 2, TYLER

Substation No. 2 is located ten miles northwest of Tyler and five miles southeast of Lindale, Smith County, on State Highway No. 37; latitude 32 degrees 28 minutes north and longitude 95 degrees 21 minutes west; elevation approximately 504 feet above sea level. The average annual rainfall for the past 33 years has been 42.77 inches. The average date of the last killing frost in the spring is March 16, and the first in the fall November 17. The station farm consists of 455.2 acres of land, of which approximately 170 acres are occupied by the East Texas Soil Conservation Experiment Station and operated by the Soil Conservation Service of the United States Department of Agriculture in cooperation with the station. The remaining area is utilized for pasture investigations, including the use of beef and dairy cattle, agronomic, and horticultural investigations. Part of the pasture land is also being used to obtain additional erosion and runoff data on pasture land. At the present time, 35 acres are available for agronomic and horticultural crops, 150 acres are in cleared pasture, and approximately 95 acres are in woods of which 34 acres are pastured.

The soil is predominantly fine sandy loams of the Kirvin, Bowie, and Nacogdoches series, with smaller areas of other series. The topography is very rolling, with slopes ranging from 3 to 20 per cent. There is a difference of 159 feet vertical elevation between the low and high points of the station.

The principal problems of this station deal with (1) the conservation and utilization of the upland soils, which, to a considerable extent, are depleted by cropping and erosion, (2) the production of various agronomic and horticultural crops, and (3) the protection of these crops from diseases and insects.

Soil Fertility Studies

Cotton: Studies to determine the relative value of hairy vetch and oats green-manure crops, and commercial fertilizers for cotton production are being conducted. The results indicate that for lint production, a hairy vetch green-manure crop, fertilized in the fall with the equivalent of 400 pounds of 0-8-4, is approximately equal to a spring application of 400 pounds of 4-8-4. The residual effect of hairy vetch, however, is much greater than that from commercial fertilizer, as is shown by the increased yield of corn grown the following year without further fertilization.

Previous work on amount and grade of commercial fertilizer showed all three of the usual fertilizer ingredients can be profitably used, and that a narrow ratio between the nitrogen and phosphoric acid is desirable. The most profitable fertilizer for cotton, per acre, has been 400 pounds of 4-6-4, although 200 pounds has returned the greatest profit for money invested in fertilizer. Part of the results have been published in Bulletins 469 and 490.

Corn: Previous work has shown that green-manure crops, in themselves, are not profitable for corn, because of the necessity of turning them under in time for early corn planting. The results secured in 1937 indicate, however, that the accumulated effects of green manure crops result in profitable increases in corn production. A treatment in which hairy vetch has been grown each year in a two-year rotation of cotton and corn produced 33.4 bushels per acre, an increase of 41.9 per cent over the untreated plots; while a series which receives vetch in alternate years preceding cotton, and not fertilized in any manner for corn, produced 32 bushels per acre, an ncrease of 35.8 per cent over the untreated plots, and only 1.4 bushels beow those plots on which hairy vetch is turned under each year. The value of the organic matter is shown by the fact that the plots which received 100 pounds of sulphate of ammonia produced only 28.3 bushels, an increase of 20.3 per cent over the untreated. Previous work has shown the atter treatment to be the most profitable of commercial fertilizer applications where corn follows a liberally fertilized cotton crop.

Use of Fertilizers on Pastures: In cooperation with the Tennessee Valley Authority, a test was initiated this year to determine the effect of various applications of fertilizer increased the total yield of grass. Nitrogenous fertilizers, especially, were effective in stimulating early grass, while combinations of nitrogen and phosphoric acid held up well into the summer and showed the highest total yield. The use of manure and manure and phosphate did not indicate much benefit at the first cutting, June 11, but were only slightly below the highest yeilding treatment at the second cutting, August 19.

Variety Tests

Cotton: The cotton variety test in 1937 consisted of eight varieties. The shorter stapled Half and Half and Hi-Bred again were the highest producing varieties, yielding 367 and 366 pounds of lint per acre, respectively. Bryant Mebane, in its initial appearance in the test, produced 357 pounds. Over a period of years there is a distinct negative correlation between ength of staple and yield. Of those varieties producing tenderable staple, he Mebane and Lankart types are the most profitable when central market quotations for various staple lengths are considered.

Corn: Jarvis Golden Prolific led the fourteen varieties in the corn ariety test in 1937 with 31.3 bushels per acre, and was followed by Yellow Surcropper '36, Reese Drouth Resister, and Golden June with 21.9, 28.8, nd 28.1 bushels per acre, respectively. Good's Golden Prolific, Improved

Golden, and Hasting's Prolific were low with 17.7, 19.9, and 20.1 bushels per acre, respectively. Each of three Yellow Surcropper strains outyielded the White Surcropper, and Golden June produced more than the Mexican June.

Summer Legumes: The Brabham cowpea produced the highest yield of air-dry forage, 3.28 tons per acre, of the seven cowpea varieties in the test in 1937. Groit was low with 0.75 tons; this variety is usually one of the highest. Crotalaria spectabilis and Bunch velvet bean, as usual, produced heavily, but were exceeded this year by the Brabham cowpea. Seed yields are not available for this report.

Soy Bean Varieties: Sixteen varieties of soy beans were planted at three different dates in a variety-date of planting test. The Laredo variety produced the highest yields of air-dry forage at both the April 2 and June 8 plantings and on the average for the three plantings. Biloxi was high at the May 4 planting, Laredo being second. Apparently, there was a tendency for the yields to increase as the date of planting was delayed, this being especially true of the quick maturing Manchu and Virginia varieties, and to a lesser extent for a number of the others. In only three out of sixteen varieties did the April 2 planting produce more than the May 4 planting. Seed yields were low, as usual.

In a rate of seeding tests involving the Laredo and Mamloxi varieties, there was no significant difference in the yield of Laredo when the seeding rate was varied from 20, to 30, 40, and 50 pounds per acre. The 30 pound rate yielded slightly higher than the others. A greater difference was noted in the Mamloxi variety, with the 40 pound rate producing the highest yield and the 20 pound rate the lowest.

Winter Legumes: The test of winter legumes at this station has shown hairy vetch to be consistently the highest yielding of all of the varieties under test. Other varieties have at times yielded more than hairy vetch, but a period of years average shows the latter to be by far the outstanding winter legume. The 1937 yields were no exception in that hairy vetch produced the highest air-dry yield, 1.685 ton per acre, which was 40 per cent above the next highest, Canada field pea. The latter did unusually well this season. Applications of 150 pounds per acre of superphosphate in the fall before seeding continues to give large increases in yield.

Crop Improvement

Two crop improvement projects are carried, both of which are in their early stages. The purification of the Gooseneck sorgo, through selfing, is in the second year. A number of hybrid cowpea selections were made in the breeding program to produce a desirable disease-resistant cowpea.

Pasture Improvement

Work on pasture improvement was continued with results as previously reported. The use of plowed strips on the contour at regular intervals own the slope continues to be the most satisfactory method of establishing ermuda sod on old worn-out cultivated fields when soil conservation is esired in connection with the sodding operation. Where the erosion isk, is not great, cultivation of the entire area will expedite sod formation.

Mineral Requirements of Cattle

Hereford Steers: The same group of steers as used in 1936 were carried hrough the winter, grazing season, and a 70-day dry-lot period in the test omparing salt licks of salt, salt and di-calcium phosphate, salt and bone ieal, and salt, lime, bone meal, and cotton seed meal. Again there was o signficant difference between the various lots that could be attributed o the salt licks.

Jersey Heifers: Eight Jersey heifers, five of which were also used last ear, were used to compare a mixture of two parts bone meal and one part alt with salt alone through the wintering period and the summer grazing eriod. During the winter these heifers received supplemental feed consistng of sorgo silage, grass hay, and cotton seed meal; during the grazing eason no supplemental feeds were given. The results indicated a decided enefit from the bone meal during the summer but none during the winter. he mineral requirements during the winter were evidently well taken are of by the 1.0 to 1.5 pounds of cotton seed meal per head fed at that me.

P. R. Johnson.

Horticultural Experiments

Rose Investigations

Culture Experiments: The first year's results of the fertilizer experients indicate a preference by roses of a relatively low nitrate and phoshate application unless gypsum is present. The field where the fertilizer lats were located had been out of cultivation and in pasture for at least fteen years. It is entirely possible that sufficient nitrates and phosphates ere available for the plants. This is indicated by the depressing effect otained by very high nitrate and phosphate applications. There seemed be no consistent relation between amount of die-back and fertilizer sed.

An apparent relation was found between plant vigor and incidence of die-ack. Vigor, when decreased by defoliation or increased by removing all ower buds, was found to be correlated with rate and completeness of abission layer formation at the base of the flower peduncle. Die-back is ssociated with a fungus infection through the bloom. A vigorous plant eems to lay down a complete abscission layer more rapidly than a less gorous plant and the peduncle abscisses before the fungus can invade e cane proper.

Little difference was found in total growth in fall budded plants when rtilized in early spring or early summer. Cotton seed meal as a nitrogen carrier in a complete 6-9-3 when applied in April or ammonium sulphate in a 6-9-3 in May seemed to decrease the amount of die-back injury slightly.

Understocks: Of the various understocks under test, *R. multiflora* Chenault was found to be particularly good from the standpoint of high percentage of rooting of cuttings, high bud live, and excellent plant growth. I. X. L., while low in percentage of rooting as cuttings, gave a high bud live and produced excellent plants. Nine understocks budded to five varieties of hybrid tea roses were sent to New York, Ohio, and to Denton, Texas, for test and observation as to behavior under these widely different climatic and soil conditions. The collection of understocks now being grown for similar testing in the future numbers 36.

Approximately 6000 species of crosses were made in the spring for the purpose of developing a better understock than is now available. Of these, 1200 crosses were successful and more than 12000 seeds were obtained. About 40 new species and several horticultural varieties that have promise as understocks were added to the species collection in the past year.

Storage and Harvesting Experiments: Repetition of pruning experiments on plants at time of transplanting verified the results obtained in 1936. Tops must be pruned enough to prevent undue drying but not so heavily that plants are weakened because of removal of wood in which starch is stored. Under the conditions at Tyler pruning tops to ten inches resulted in maximum bloom production and a very low mortality rate of the transplanted bushes. Drying of plants before transplanting again resulted in an increasing mortality rate and a decreasing number of blooms produced as the period of exposure to dry moving air increased.

Storage of rose bushes at 45-50 degrees was found to be very unsatisfactory. Die-back developed rapidly in the plants, even though die-back infected wood had been removed from infected plants with sterile shears and the open ends coated with wound dressing. Mold developed on the canes in the high humidity vaults unless the air was circulated by a fan for ten minutes at thirty minute intervals.

Fruit Investigations

Peaches: Peach production was practically nil for most varieties as a result of abscission of flower buds. The cause for the drying and dropping of the buds is not known, but it is probable that the severe drought the preceding summer may have had much to do with it. Peach varieties Up-to-date, Arp Beauty, and Carmine were the only varieties that produced fruit.

Blackberries: Three years of data on the effect of various fertilizers and of different methods of pruning and thinning of Lawton Blackberries yielded the following results. A 4-8-4 fertilizer at the rate of 600 or 800 pounds per acre increased the yield over the no fertilizer plats about 40%. Removing old canes and pruning new canes to four feet either after harvesting or in January gave the best yields in the pruning series. Thinning to three new canes for each two feet of row gave best yields in the thinning series and produced as much fruit as the treatment where old canes were removed and new canes pruned to four feet.

J. C. Ratsek.

Rose Diseases

Field Control of Black-spot and Die-back of Roses: Data from experiments with the Luxembourg variety showed the effectiveness of two fungicides, a dust containing 300 mesh sulphur and Cuprocide, and a spray composed of Bordeaux, wettable sulphur, and Kayso. Approximately 92 per cent control of black-spot was obtained by the treatments. Disbudding (removal of flower buds before they opened) during the growing season did not influence the percentage of black-spot; it did, however, improve the amount of foliage and general appearance of the plants. The best results were obtained where disbudding was done in conjunction with the use of fungicides. Die-back disease was not sufficiently extensive in any of the plots to yield information as to its control.

Streak Disease of Roses: A virus disease called "streak" was found to have a rather wide distribution and to affect at least three varieties of roses and probably more. The effect of the disease was to cause a weakening and stunting of the plants. Experiments were started for the purpose of adding to the present knowledge concerning the means of transmission of the virus.

Gloeosporium Cane Canker of Rose: A conspicuous, black, cane canker of rose was observed to be doing considerable damage in a planting of Luxembourg roses at the substation. The cankers resulted principally in a girdling of the canes, followed by their death. Approximately one cane per ten plants in a field of about 2000 rose plants was observed to be infected. The effect on this disease of fungicidal and disbudding treatment was negligible.

An Unidentified Cane Disease of Roses: A necrotic and hyperplastic type of disease was noted on Caledonia, and subsequently on Radiance and Mrs. E. P. Thom. The disease is characterized by roughened, hydrotic swellings in purplish-black areas of the rose canes. The possibility of bud transmission is being studied.

E. W. Lyle.

Insect Investigations

Thrips: Thrips caused rather severe damage to cotton in some fields for a short time after plants came up. Leaves were distorted in shape and many plants had an excess of leaves. In most fields plants seemed to recover from the injury.

Heliothis obsoleta: Bollworm injury to cotton was negligible on all fields under observation. Seven eggs per 100 buds of as many plants was the largest number found on twenty fields. Moths which emerged from larvae that had fed on corn probably laid eggs mainly on cowpeas, since this crop is usually planted with corn.

Observations were made upon the activity of this insect upon corn for the purpose of determining factors influencing infestation of the insect in cotton. Oviposition on small corn plants was not heavy, fifteen eggs per 100 plants being the largest number found. An average of 12 per cent of plants in five fields showed injury by the earworm. The number of eggs recorded on silks was not large in most cases but more than 85 per cent of ears were entered by the larvae. Since mortality was high, and since many larvae fed the silks and tip of the ear, damage was not severe on varieties with long husks.

Of twelve varieties under observation at the Substation, the prolific varieties showed less damage by the earworm than did any of the others. These varieties silked several days later than the other varieties. This allowed the bulk of oviposition to take place on the other varieties. Yellow Surcropper showed heaviest damage because of earliest silking and a very short husk.

In order to determine if *Heliothis obsoleta* has a host preference, infestation records were made on tomato plantings adjacent to corn and on others removed from corn. The average number of damaged fruits was about 5 per cent for each field. Since this was a light infestation, and since all fields had about the same percentage of damaged fruits, there was no indication that either host was preferred. Corn plantings near tomatoes had infestations comparable to those in plantings away from the crop.

Peach Tree Borer: A crude cottonseed oil emulsion impregnated with paradichlorobenzene and applied as a spray on young trees has been recommended for several years as a control of the peach tree borer. In order to compare the effectiveness of this method with the standard paradichlorobenzene crystals treatment, which has been used for many years, the two treatments were applied to separate sets of trees on October 24, the same amount of paradichlorobenzene being applied in each case. Examinations five weeks later showed the standard paradichlorobenzene crystals treatment had killed 89.32 per cent of the borers, while the emulsion had killed 97.32 per cent of the live stages in the trees. It is believed that the increase in kill by the emulsion treatment was mainly due to the fact that gas is liberated faster from the spray treatment under cool weather conditions.

W. L. Owen, Jr.

Soil and Water Conservation Investigations

(In cooperation with the Soil Conservation Service, U. S. Department of Agriculture)

Research work in soil and water conservation is being conducted by the Soil Conservation Service in cooperation with the Texas Agricultural Experiment Station. The principal work of the Tyler Soil and Water Conservation Experiment Station is the measuring of run-off and soil losses from fields and plots under different conditions. The effects of such factors as vegetative cover, degree of slope, length of slope, arrangement of crops, cultural practices, and size and shape of area are being measured and studied. This information on the amounts, causes, and means of controlling soil and water losses forms a basis for the development of practical methods of conserving soil and water in this region.

The experiments are located on Kirvin, Nacogdoches, and Bowie fine sandy loam soils on slopes varying from 4 per cent to 16½ per cent. Kirvin is a rather poor and very erodible soil. Nacogdoches is a more productive and less erodible type. Bowie, found on gentler slopes, is generally less erodible than the Kirvin but erodes severely when saturated.

Soil and water losses: The soil and water losses for 1937 were considerably lower than for any year since the studies were started. These low losses may be directly attributed to the unusually low rainfall intensities during the spring months. The two most erosive rains occurred on June 6 and November 15. The maximum rate for a 5-minute period for these two rains was 1.92 and 3.48 inches per hour, respectively.

Strip cropping: Results for the period of study 1935-1937 have indicated that strip cropping is an effective method of reducing soil losses. It remains to be determined just how far we may safely go in recommending this practice, and a great amount of information is needed as to limits of degree and length of slope, widths, and spacing of strips, and the types of crops that can safely be used in strip cropping.

The effect of slope characteristics on soil and water losses: The results for the period of record 1931-1937 indicate a definite tendency for soil losses to increase with an increase of slope grade and length; however, there is not a corresponding increase in the amount of water losses from increased slope lengths. In 1937 the soil loss on a plot 36.3 feet long was 5.55 tons per acre as compared with 6.26 tons per acre on the adjacent plot 72.6 feet long; whereas, over a period of six years 1931-1937, the plot 36.3 feet long had an average soil loss of 18.62 tons per acre as compared with 29.95 tons of soil per acre on the adjacent plot with a slope length of 72.6 feet. It is of interest to note the small difference in soil loss in the two different slope lengths for 1937 as compared with the six-year average losses between the two slope lengths when more normal rainfall intensities were experienced.

The effect of plant cover on soil and water losses: The results of the period of investigation 1931-1937 indicate very conclusively that plant cover is an important factor in controlling soil and water losses. Limited data indicate that the use of winter cover crops aid materially in decreasing the amount of losses during the winter months.

The effect of burning woods on soil and water losses: Data for the period of record 1932-1937 show conclusively that the practice of burning of wooded areas annually results in an increase in soil and water losses.

The effect of terrace characteristics on soil and water losses.

Terrace grade: Results from these studies indicate that run-off and erosion losses decrease as the terrace grades decrease. Terraces with the 6-inch uniform grade and the variable 0 to 6-inch grade have shown excessive amounts of run-off and erosion. There is, likewise, a noticeable amount of scouring in the channels. For the terraces 700 feet long, the 0 to 3-inch variable grade terrace has not proved superior to the 3-inch uniform graded terrace in conserving soil since the variable grade has lost slightly more soil. However, the water lost as run-off was considerably less from the variable 0 to 3-inch graded terrace than from the 3-inch constant grade.

A 1700-foot terrace designed with the lower 450 feet on a grade of 3 inches per 100 feet; the next 450 feet graded 2 inches per 100 feet; the next 450 feet, 1 inch per 100 feet, and the remaining 350 feet, level, has been more effective in conserving both soil and water than a 1700-foot terrace with a uniform grade of 3 inches per 100 feet. The 350-foot level section has caused no appreciable ponding of water in the channel.

Vertical spacing: From data secured during the course of these studies, there is no conclusive evidence indicating that there is a well-defined optimum terrace spacing for soil and moisture conservation. A terrace 700 feet long on an average land slope of 6 per cent with a vertical spacing of 6 feet, lost 21 per cent less soil and 4½ per cent more rainfall as run-off than a terrace on a slope of 6.44 per cent with a vertical spacing of 5 feet. Likewise, a 700-foot terrace on a slope of 6.43 per cent with a vertical spacing of 4 feet lost less soil and more moisture than a terrace on a 6.67 per cent slope with a vertical spacing of 3 feet. The longer terraces have also shown the lack of a consistently increased soil loss with continued increased vertical spacings, and, likewise, the lack of a definite relationship between the amount of the soil loss and the amount of run-off. Observational studies, both on the terraces under measurement and those under observation alone, indicate that excessive gully erosion may develop between terraces on the 6- and 7-foot vertical intervals. At the same time, economical considerations may preclude the use of decreased vertical spacings under those in use on some of the experimental terraces.

Length of terraces: All terrace lengths up to the maximum under observation and measurement, 2300 feet, have been satisfactory. The maximum rain of May 8-10, 1936, when an intensity of 6.48 inches per hour for a 5-minute period was recorded after the ground was fully saturated, caused only a slight over-topping of the 2300-foot level terrace.

The effect of terracing on soil and water losses: Data for the period of record reveal a soil loss for the terraces approximately 89 per cent less than the unterraced cultivated watershed, measurements being made at the outlet ends of the terraces and at the lower end of the unterraced watershed. The most significant difference, however, is perhaps the apparent tendency for the soil losses on the unterraced area to increase from year to year and, likewise, the very evident increase in the number and size of the gullies within the watershed.

J. B. Pope, O. C. Ward, J. C. Archer, S. C. S., U. S. D. A.

SUBSTATION NO. 3, ANGLETON

Substation No. 3 is located 3.1 miles northeast of Angleton, Brazoria County, adjacent to the St. L. B. & M. Railroad. The latitude is 29 degrees north and the longitude 95 degrees west with an elevation of 23 feet above sea level. The average annual rainfall over a period of 24 years was 45.85 inches. The maximum temperature for the same period of time was 105 degrees F. and the minimum temperature for the same period of time was 10 degrees F. The average relative humidity for a period of 23 years was 79.8%, and the average annual evaporation for the same period of time was 44.789 inches. The mean monthly wind movement for a period of 24 years was 3588 miles. The average date of first killing frost in the fall is December 1, and the last killing frost in the spring is February 27, giving an average growing season of 277 days.

The growing season of 1937 was characterized by a dry spring. The months of April and May had no effective rainfall. June had a normal precipitation, while that of July was about 3 inches below normal. The total departure during the year was 7.86 inches below normal. In spite of the lack of moisture during the spring months the crops that were planted early made yields consistently above average. Cotton and corn planted late made almost complete failures because of insect activity. Shrock kafir planted in June made an excellent yield.

Cotton: Eighteen varieties were grown in the cotton variety test in 1937 with six replications of each variety. The cotton in this test was planted at the normal planting date and the stands were good. While this cotton suffered from the dry weather during April and May, it had very little insect damage. Deltapine 32 (D & P 11A) made the highest average yield with 547 pounds of lint cotton per acre followed in order by Stoneville 5, Mebane 804-50, Mebane 804-36, Half and Half, New Boykin and Rogers Acala with acre yields of 539 pounds, 496 pounds, 489 pounds, 475 pounds, 467 pounds and 458 pounds of lint cotton per acre respectively. Of the varieties above mentioned Rogers Acala, Deltapine 32 and Stoneville 5 had a length of lint from 1 1/16 to 1 1/32 inches. Half and Half had the shortest staple with 7/8 inch.

D & P L 11A has been grown at this station during the three years 1935 to 1937 inclusive and has been an outstanding variety in yield, having led all varieties by a substantial margin during each of the three years. The three-year average yield of lint cotton per acre for D & P L 11A was 466 pounds, followed by Stoneville 5 with 412 pounds, Rogers Acala with 409 pounds, Mebane 804-50 with 402 pounds, Half and Half with 401 pounds, and New Boykin with 379 pounds. D & P L 11A is the variety that is being recommended for this section of the state and is being accepted as the variety to be grown in a number of one-variety communities in the Gulf Coast section. In addition to being a high yielder D & P L 11A has a lint percentage of 38 to 40%, a length of lint from 1 1/32 to 1 3/32 inches and a medium to small boll size of about 75 bolls per pound.

Further selections were made in the cotton breeding work from strains obtained from the Mebane 804 variety. The inbreeding work was continued to study the effect of inbreeding as compared with straight plant selection on the uniformity and yield of cotton. A number of promising plant selections were obtained from this work in 1936 and were grown in plant rows in 1937. The selections grown in plant rows in 1936 were grown in replicated plats in 1937, using Mebane 804-36 as the standard of comparison. A few of these selections were promising enough for further testing in 1938.

Backcrosses of hybrid Mebane strains of cotton to obtain a high lint percentage on good yielding strains were continued in 1937. The wilt resistant crosses made in 1936 were backcrossed on Mebane 804-36 in 1937 in order to incorporate the wilt resistant factor into this Mebane strain.

Corn: Eighteen varieties of corn were grown in a variety test in 1937. The yields were good, and this is the first year since 1929 that satisfactory yields have been made on this station largely because of extremely unfavorable weather conditions during the growing season. The weather conditions during 1937 were favorable for the early maturing varieties and as a group these early varieties made the highest yields. White Surcropper made the highest yield this year with 38.8 bushels, Red June with 36.1 bushels, 1937 Yellow Surcropper with 36.0 bushels, Mexican June with 34.7 bushels, Golden June with 34.6 bushels, and Reese Drouth Resister with 34.3 bushels. Of the late corn Yellow Tuxpan made this year a higher yield than White Tuxpan. All of the varieties named are adapted to this section of the state. The June corns produce a better quality of grain than the Surcropper varieties in this section and over a period of years will make about the same yield. For this reason we recommend the use of White June, Red June, or Golden June for an early variety and Yellow Tuxpan or White Tuxpan as the late maturing varieties.

The corn breeding work was changed in 1937, and the work will be continued with the object of increasing the yield and improving the type of Yellow Tuxpan. In 1936 500 ears of Yellow Tuxpan were selfed and 36 of these ears were selected for type. Each of the 36 ears was planted in four replications in 1937, and all were detasseled. Each third row throughout the plat was planted to a massed lot of 50 selected open pollinated ears and those rows were used as the pollen rows. Each of the four rows of the 36 selfed ears was harvested separately and the yield and type determined. The ten best selections from the 36 ears will be planted in the variety test in 1938, and selected ears from these lots will be used as the pollen rows in 1938, while 36 ears selected from 500 self-pollinated ears from the 1937 pollen rows will be carried in the same manner in 1938.

The yellow Sweet Tuxpan was planted for increase in 1937, but most of the ears molded before maturing. Because of the high humidity of this region it may be very difficult to grow sweet corn for seed.

In a comparison of corn and Shrock Kafir for grain yield the average yield of corn was 7.8 bushels per acre as compared with 25.4 bushels for Shrock Kafir. This test was planted in June, which was entirely too late for the corn, but the Shrock made an average yield. The nine year average yield of corn in this test is 15.3 bushels and that of Shrock Kafir 22.1 bushels.

Forage yields of corn and sorghum varieties: Considerable difficulty was encountered in obtaining adequate stands this year. As in 1936 Mammoth Russian Sunflower was included in the test. The highest yield of air-dry forage per acre was made by Shrock Kafir with 3.40 tons, followed in order by Amber with 2.92 tons, Orange with 2.23 tons, Mammoth Russian Sunflower with 2.02 tons, Hegari with 1.74 tons, Red Top with 1.72 tons, and corn with .93 tons. Red Top and Hegari have comparatively poor stands. During the past four years Orange has made the highest average yield with 3.49 tons of air-dry forage per acre, followed by Shrock Kafir with 3.40 tons, Red Top with 2.96 tons, Amber with 2.88 tons, Hegari with 2.57 tons, and corn with 1.29 tons.

Wheat and Oats Rust Nursery: A wheat and oats nursery planting of rust resistant strains was made at Victoria in November, 1936. Largely because of the wet condition of the soil at the time of planting, poor stands were secured on all plats and no yields were obtained this year. However, notes were taken on the rust resistance of all strains, and the plants were harvested to obtain information on the type and quality of grain produced. This information has proven valuable, since a number of the poorly adapted strains can be eliminated from further testing. The resistance to rust of most of these strains is good and the outlook is excellent for obtaining a number of well adapted strains of both wheat and oats.

Flax: Seven varieties of flax were planted in replicated plats at Angleton and Victoria in November, 1936. The growth of these varieties was excellent and the chances for better yields than in 1936 appeared good. After the seed pods were formed, a disease known as Pasmo appeared, which apparently cut the yields in half. This disease is common in South America and was apparently introduced in the South American seed planting. The yields at Angleton ranged from 3.5 bushels to 9.7 bushels per acre and at Victoria from 4.5 bushels to 7.6 bushels per acre. Because of the danger of introducing this disease in South American seed the Bison variety, which is widely grown in the north, is recommended for commercial planting, and 100 bushels of certified seed of this variety were distributed in South Texas during the fall of 1937 for a number of plantings on commercial scale.

Permanent Pastures: The seven head of steers on the unimproved pasture were sold on June 17, and the seven head on the improved pasture were sold on November 17. The steers on the unimproved pasture averaged 843 pounds liveweight and had a 56.7 dressing per cent. Two of the carcasses graded No. 5; two, No. 6; and three, No. 7. The steers on the improved pasture averaged 1010 pounds liveweight, had a 58.5 dressing per cent, and graded from 3 to 4. Based on the market prices at the two different selling dates, the value of the steers on the improved pasture was from 1 3/4c to 2c per pound liveweight more than that of the steers on the unimproved pasture. Six of the steers on the unimproved pasture had liver flukes; three on the improved pasture had liver flukes, only one of which was bad. The improved pasture consisted largely of Bermuda, Carpet, and Dallis grasses, with some common lespedeza, and had been mowed to control the weeds. The native or unimproved pasture consisted largely of Little Bluestem, with some Big Bluestem, Bushy Bluestem, and various weeds.

Mowing is recommended as the best and most economical method of controlling weeds in the pasture in the Gulf Coast region.

Summer Legumes: In the variety test of summer legumes other than soy beans, Sesbania made the highest yield of air-dry forage in 1937 with 2.58 tons per acre as compared with 2.55 tons for Brabham cowpeas, 2.39 tons for Crotolaria Spectabilis, 2.21 tons for Beggarweed, and 2.03 tons for Groit cowpeas.

For the six years tested, Sesbania has made the highest average yield with 2.50 tons of air-dry forage per acre as compared with 2.12 tons for Crotolaria Spectabilis, 1.87 tons for Otootan soy beans, 1.63 tons for Laredo soy beans, 1.41 tons for Biloxi soy beans, and 1.30 tons for Brabham cowpeas.

A variety and date of seeding test with sixteen varieties of soy beans was carried this year. The early planting was made on April 12, the medium planting on June 16, and the late planting on July 14. The early planting made by far the largest yields and the late planting was almost a failure. The plantings should have been made at two-week intervals, but the lack of moisture made it impossible to carry out the test as planned. The varieties making an average yield of over one ton of air-dry forage per acre at the early planting were Delnoshat, Laredo, Otootan, Biloxi White Biloxi, Avoyelles, Tokio, and Mamloxi. Their yields ranged from 1.64 tons to 1.13 tons per acre in the order named. The seed yields on all of these varieties were very poor, only six maturing any seed at all. Mamredo made the highest seed yield with 296 pounds per acre. In the two-year average, 1936 and 1937, Laredo made the highest average yield of air-dry forage per acre at the early planting with 1.46 tons followed by Delnoshat with 1.30 tons, Mamloxi with 1.12 tons, and Biloxi with 1.11 tons.

In all cases the early planting made a higher average yield than the medium planting, and the late planting made the lowest yield. The seed yields were all low and the seed produced was of a very poor quality.

The soy bean inoculation and rate of seeding test was conducted with the Mamredo variety. The seeding rates were 20, 30, 40, and 50 pounds of seed per acre. There was little consistent difference in the forage yields other than the 20 pounds per acre seeding rate. The lower seeding rate produced the lowest yields of forage. There was no consitent difference in the inoculated yields as compared with the plats not inoculated. This test has been carried for two years with similar results both years.

In addition to the soy bean varieties carried in the variety and date of seeding test, 56 new strains of soy beans were received from the U. S. D. A. and were planted in single row plats. F. P. I. No. 7151 made the highest yield of air-dry forage with 2.81 tons per acre, followed in order by F. P. I. No. 86731 with 2.73 tons, F. P. I. No. 94166 with 2.44 tons, and F. P. I. No. 71570 with 2.09 tons, as compared with 1.92 tons for the Mamredo checks. Of the new strains carried in this test in 1936 and 1937 F. P. I. No. 91466 made the highest average yield with 2.11 tons of air-dry forage per acre. Seed yields in 1937 were good on some varieties, the highest yield being 1142 pounds per acre made by F. P. I. No. 84739. The second highest yield was made by F. P. I. No. 85348 with 1069 pounds per acre. However, all varieties had a large percentage of shriveled or molded seed and none of them were of a good market grade.

Other parts of the country have shown marked increases in yields of peanuts where the vines were dusted several times during the growing season with dusting sulphur. Where replicated plats received four dustings with sulphur in 1937 the average yield of forage was 2.32 tons per acre, as compared with 2.59 tons for the plats not treated and 44 bushels of nuts per acre as compared with 51 bushels for the plats not treated.

Winter Legumes and Grasses: A number of varieties of clovers, vetches, winter peas and Rescue, Italian Rye, and Dallis grasses were grown in a variety test in the winter of 1926-937. Hubam clover made the highest yield of air-dry forage per acre with 2.59 tons, followed in order by Alsike clover with 1.64 tons, Red clover with 1.48 tons, Subterranean clover with 1.30 tons, and Purple vetch with 1.26 tons. Of the three grasses grown Italian Rye made the highest yield with .44 tons, as compared with .40 tons for Dallis grass. The winter peas made very poor yields this season.

For the past six years Hubam has made the highest average yield with 1.79 tons per acre, followed in order by Hairy vetch with 1.49 tons, Subterranean with 1.45 tons, Italian Rye grass with 1.41 tons, Red clover with 1.39 tons, and White Dutch clover with 1.36 tons.

Fertilizers: The Gulf Coast prairie soils respond to fertilizer application and the chief need of these soils is phosphoric acid and nitrogen. Potash has been of little value. The main fertilizer test on this station consists of six acres in a three-year rotation of corn, cotton, and cotton.

Each fertilizer treatment except the checks appears twice in the corn and four times in the cotton. An application of 400 pounds of 4-12-4 per acre is used as a check and appears on every 6th or 7th plat. The nitrogen, phosphoric acid, and potash are varied independently from the 4-12-4 formula, and the applications range from 200 to 1000 per acre. The different formulas are all mixed on the station and are made from 20% ammonium sulphate, 34% superphosphate, and muriate of potash. In addition to the main fertilizer test, a potash test with cotton and a source of nitrogen test was carried this year.

In the cotton fertilizer test the fertilizer formula making the highest yield of the 440 pound applications was 8-12-4, which gave a yield of 619 pounds of lint cotton per acre. This was followed in order by the 6-12-4 formula with 579 pounds per acre and the 4-6-4 formula with 574 pounds per acre, as compared with a yield of 445 pounds on the no treatment plats. Increasing the application of the 4-12-4 fertilizer by 200 pound intervals from 200 to 1000 pounds per acre produced yields of 489 pounds, 562 pounds, 584 pounds, 668 pounds, and 715 pounds of lint cotton per acre, respectively. Of the 800 pound per acre fertilizer application the 8-12-8 gave the highest average yield per acre with 804 pounds per acre, followed in order by the 8-12-6 formula with 796 pounds per acre and the 8-12-4 formula with 744 pounds per acre. These results indicate some benefit from potash this year. In the six-year average yield in the cotton fertilizer test nitrogen and phosphoric acid gave the greatest yield, while potash was of little value. As the amount of fertilizer per acre is increased, the ratio between the nitrogen and phosphoric acid should be narrowed.

In a potash test with cotton where a blanket application of 400 pounds per acre of a 4-12-4 formula is made and where in addition 250 pounds and 500 pounds per acre of muriate of potash is used, the increased application of potash gave respective yields of 609 pounds and 688 pounds of lint cotton per acre, as compared with an average yield of 678 pounds of lint cotton on the plats receiving no potash in addition to that of the 4-12-4 formula. The five-year average yield in this test was 400 pounds of lint cotton per acre for the 4-12-4 plats as compared with 392 pounds of lint cotton per acre where 250 pounds of muriate of potash was applied and 411 pounds of lint cotton per acre where 500 pounds of muriate of potash was used. These results show no consistent benefit from the use of the large amounts of potash.

In the regular fertilizer test with corn in 1937 the complete fertilizer formula gave larger increases in yield than any in which one of three elements was lacking. Increases in the amount of fertilizers used produced consistent increases in yield, although the increases were small. In no case was the increased yield from the use of fertilizer profitable. During two of the seven years that this test has been conducted, the application of fertilizer produced no significant increase in yield because of unfavorable growing conditions. Significant increases in yield were obtained during the other five years, and nitrogen and phosphoric acid were responsible for these increases. Potash has been of little value except in 1937. The fertilizer applications have not proven profitable as shown by the seven year average yields, and as a farm practice the residual effect of the use of fertilizer on preceding crops should be relied upon for corn production.

In the corn source of nitrogen fertilizer test where a 400 pound application of a 8-12-0 fertilizer was used, ammonium sulphate as the source on nitrogen produced an average yield of 22.5 bushels per acre as compared with 18.2 bushels where cyanamid was the source of nitrogen and 17.8 bushels where nitrate soda was the source of nitrogen. Where no nitrogen was used, the average yield was 12.0 bushels per acre, about the same yield as the no treatment plat. This test was conducted on land that had been in cultivation since 1911 and where no fertilizers had been used previous to 1936. The percentage increases in yield in this test were much greater than those obtained in the regular fertilizer test on similar land that had been in cultivation since 1927.

In 1937 pasture fertilizer test was conducted by using varying amounts of nitrogen from ammonium sulphate and phosphoric acid from superphosphate applied to the surface of the sod consisting largely of Carpet grass. No significant increases in yield were obtained from phosphoric acid only, and while increases were obtained from the use of nitrogen and phosphoric acid the increases were not profitable. The yields were obtained from monthly cuttings of the plats, and no chemical analyses have been obtained to date on these samples. In order for the fertllizers to be profitable the fertilized plats should produce forage of a considerably higher feeding value. The no treatment plats average 2615 pounds of air-dry clippings per acre as compared with 2675 pounds where 40 pounds of available phosphoric acid was applied and 2844 pounds of clippings where 20 pounds of available nitrogen and 40 pounds of phosphoric acid per acre were applied. This is the second year this test has been conducted and the results were very similar in both years.

Time and Method of Seedbed Preparation Test: This project was started in 1932 and the land is prepared in the fall or spring or both and is bedded, flat broke, or both. All combinations are used and cotton and corn are grown in a three year rotation, each method of preparation appearing once for corn and twice for cotton. The fall preparation is made as soon as the crops are harvested and the soil conditions will permit, and the spring preparation as soon after February 1 as soil conditions will permit. In 1937 the highest average yield of cotton was made on the plats that were bedded in the fall and rebedded in the spring. The average yield was 626 pounds of lint cotton per acre, followed by fall flat breaking and spring bedding with 596 pounds of lint cotton per acre, and fall flat breaking and spring flat breaking with 558 pounds of lint cotton per acre. The lowest yield was produced on the plat bedded in the fall only, which produced 459 pounds of lint cotton per acre. In the five-year average there was no significant difference in yield between the plats that were flat broke in the fall and bedded in the spring, that were bedded in the fall and rebedded in the spring, or that were flat broke in the spring only. Fall flat breaking only produced the lowest yield of lint per acre. In the corn test, bedding in the spring only produced the highest yield in 1937, followed in order by the plat bedded in the fall and rebedded in the spring, and by the plat flat broke in the fall and bedded in the spring. The stand of corn in this test was poor, showing great variation between the methods of preparation, and the yields correspond closely with the stands. The stand obtained may have been influenced by the method of preparation. In the five-year average the spring bedding or fall bedding and spring rebedding have produced the highest yields, largely due to their better stands.

Cotton Green Manure Test: A test was started in 1937 using Yellow Annual Sweet clover as a winter green manure crop and using a 4-8-4 fertilizer part of which was applied in the fall on some plats and all of which was applied in the fall or spring on other plats. This test was started to obtain information on the effect of fall application of fertilizers or fall fractional application of fertilizer on the growth of Yellow Annual Sweet clover and to determine their combined effect on the succeeding cotton crop. A poor growth of clover was obtained on all plats, although a good stand was obtained, and no effect of the fertilizer application could be determined on the clover. Because of the dry spring weather the cotton could not be planted until June and the yields were almost a complete failure. No conclusions can be drawn from this year's test.

Rotation Studies: Winter clovers are grown in connection with various rotations of corn, cotton, grain sorghum, and cowpeas. This test was planted late because of the dry weather following the turning of the winter legumes and all yields were very poor. No conclusions can be drawn from the rotation studies, which have been conducted for four years.

Horticultural Work

Figs: A large number of fig seedlings were grown in 1937 from seed produced by pollinating fruit of the Magnolia, Allison, Green Ischia, and Celestial varieties in 1936. These seedlings will be transplanted into a nursery row in 1938 and are the first seedlings produced at this station in connection with the fig breeding work. A large number of varieties in the fig variety test are beginning to produce fruit and as soon as their value has been determined in this region the more promising ones will be used in the breeding work. A short crop was obtained from the Magnolia figs in 1937 largely because of the effect of the severe freeze the last day of March and the succeeeding dry spring weather.

Grapes: The grapes in the variety test at this station were injured by the late freeze and the crop was considerably below normal. Lomanto continued to produce the highest yield with 7,208 pounds, followed by Black Spanish with 1,742 pounds, Carman with 1,708 pounds, and Champanel with 1,375 pounds. During the four years that this test has been conducted Lomanto has produced an average of 7,204 pounds of grapes, which is over twice the average production of any other variety in the test. The Lomanto grape produces a fairly acid purple colored juice of a rather low sugar content but with a fairly high juice percentage.

Other Fruit and Nut Variety Tests: The crop of blackberries, dewberries, peaches, plums, and citrus was almost a complete failure this year on account of the late freeze and dry spring. A few pears were produced. A number of the pecan trees were severely injured by the late freeze and a number of the branches in the tops of the trees were killed. A few nuts were produced by the Schley and Curtis varieties this year. To date the pecans have produced very poor yields and cannot be considered adapted to commercial production on these prairie soils.

R. H. Stansel.

SUBSTATION NO. 4, BEAUMONT

Substation No. 4 is located six miles west of Beaumont on the Houston road; its latitude is 30 degrees north and its longitude is 94 degrees west; and its elevation is 26 to 30 feet above sea level. The station comprises 100 acres of land consisting largely of Lake Charles and Crowley clays, which are representative soils of this region. The average precipitation from 1915 to 1937, inclusive, was 53.18 inches. The average frost-free period is 267 days.

The purpose of this station is to serve the rice industry of Texas, and the arger part of the work is devoted to problems that confront the growers and millers of rice in this section.

Rice Investigations

(Cooperations with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture)

Variety Test

The rice varieties grown in replicated 1/50th acre field plots in 1937 were divided into early, midseason, and late maturity groups. Each maturity group was sown in a separate randomized block in which Shoemed was used as a check. In the early maturing group the yields of Shoemed, Zenith, and Early Prolific were significantly higher than those of Edith, Lady Wright, and Latex, and the yields of Edith and Lady Wright were significantly higher than that of Latex. The yields of Fortuna, Caloro, Nira, and Shoemed in the midseason group did not differ significantly but were significantly higher than those of Acadia and Delitus. There was no significant difference in yield between Supreme Blue Rose, Shoemed, Iola, and Rexoro in the late maturing group.

Nursery Experiments

One hundred and forty-one varieties and selections were grown in 3-row 16-foot plots with the rows spaced 12 inches apart. The varieties and elections were grouped into early, midseason, and late maturing groups and Shoemed was used as a check. Two early maturing selections produced ignificantly higher yields than Early Prolific. These two selections are from the crosses Edith x Blue Rose and Improved Blue Rose x Fortuna, and both appear to possess grain quality superior to that of Early Prolific. The yields of two early maturing selections from Edith x Fortuna were significantly higher than that of Lady Wright but not of Early Prolific. In the midseason group no variety or selection produced yields that were significantly higher than those of Fortuna, Nira, or Caloro. The yields of Fortuna and Nira were significantly higher than that of Calady. In the late maturing group an Edith x Kameji selection, from the Rice Experiment Station, Crowley, La., gave significantly higher yields than did Supreme Blue Rose.

A preliminary yield nursery of 150 varieties and selections was grown in triplicated 5-row 9-foot plots with the rows spaced 8 inches apart. Ninety-five of the selections grown in this test were obtained from hybrids grown in the breeding nursery which was started in 1931. Several of the more promising selections grown in this test in 1937 will be advanced to replicated 3-row 16-foot plots in 1938.

Forty-one advanced generation bulked-hybrid populations were grown in triplicated 3-row 16-foot plots and grain yields were determined. Most of the hybrid populations yielded considerably less than the Shoemed check plots.

H. M. Beachell.

Rice Cultural Experiments

Rice Variety-Date Test: Six varieties were planted at twenty-day intervals from April 10 to June 10, inclusive. Unfavorable weather conditions prevented the planting intended for March 20. Latex and Early Prolific were the earliest maturing, and Rexoro the latest variety at all dates of planting. Texas Fortuna and Nira were second in time required for maturity at the first two seedings, and about the same as Blue Rose at the third planting. Blue Rose planted June 10 matured ahead of these two varieties. The heaviest yields were obtained from the planting made May 20, with the exception of Rexoro. The earlier plantings of this variety produced larger yields than the May 20 date.

Rice Rate of Seeding: Blue Rose rice was seeded again at five rates ranging from 60 to 140 pounds of seed per acre. The lightest yield of 2205 pounds of rough rice per acre was obtained from the 60 pound rate of seeding. As the rate of seeding increased the yield increased, and the heaviest yield of 2565 pounds per acre was produced by the 140 pound rate of seeding.

Weed Control with Acid Solutions: Solutions of sulphuric acid and water containing 10, 15, and 20 per cent, by weight, of acid were applied to rice for the purpose of determining the value of such treatments for controlling weeds in rice fields. The results indicate that weeds having a rough surface can be easily controlled if the spray is applied when the plants are two to three weeks old provided the spray is applied when no water is on the land, and it is flooded shortly after spraying and kept flooded until the rice plants have attained sufficient growth to overcome any weeds that might appear later. Young rice plants suffer some injury from the heavier sprayings, but recover very quickly.

Rice Fertilizer Test: The results obtained in this test in 1937 were slightly different from those of the past few years in that the heavy applications of superphosphate did not result in a heavy growth of grass and thereby decreasing the yield of rice. This was accounted for by the fact that the fertilizers were applied in the drill with the seed this season. However, the use of superphosphate alone did not increase the yield of rice, but appeared to have been of slight value when added to the treatments of sulphate of ammonia. The use of sulphate of ammonia gave good increases in yield with the 200 pound application giving slightly more than a 48 per cent increase. Somewhat similar results were obtained in a cooperative test on a commercial rice farm, although the increases were not as large. The greatest response was from nitrogen.

Methods of Applying Fertilizers to Rice: Sulphate of ammonia and superphosphate at the rate of 150 pounds per acre each, were applied separately and in combination to rice in the drill and on top of the soil. Superphosphate used alone did not increase the yield, regardless of the manner of application. Sulphate of annmonia applied on top of the soil produced slightly better than a 15 per cent increase, but the yield was increased to 25.56 per cent when it was placed in the drill with the seed. Superphosphate appeared to be of some value when added to sulphate of ammonia as the combination increased the yield 22.65 per cent when placed on top of the soil, and 36.77 per cent when it was placed in the drill with the seed.

Sources of Nitrogen and Phosphoric Acid: Regular and granular superphosphate, Calphos, and raw bone meal were used as sources of phosphoric acid in field tests. Sulphate of ammonia and Cyanamid were used as sources of nitrogen. The results obtained were rather irregular, but some ncrease in yield was obtained in most cases. The largest increases were from the use of bone meal and sulphate of ammonia. The former gave an ncrease of 15.13 per cent, and the latter 10.56 per cent. The other amterials produced increases of less than 10 per cent.

Effects of Fertilizers on Germination of Rice Seed: Sulphate of ammonia and superphosphate were applied separately and in combinations of from 50 to 250 pounds each in the drill with seed of Caloro, Texas Fortuna, Blue Rose, and Rexoro. Counts were made on the young plants while n the seedling stage. The counts indicated there was no injury from the fertilizers being placed in contact with the seed.

Fertilizers to Rice with and without Dividing Levees: The results this season were practically the same as during the preceding years in that the indications were that very little, if any, lateral movement of the fertilizers took place when the irrigation water was added.

Fertilizer Applied in Solution to Rice: Sulphate of ammonia was applied, in solution, to rice at the rate of 200 pounds per acre. The solution containing the fertilizer was applied by adding it to the irrigation water as it entered the field. The results indicate that it would not be a practical way of applying sulphate of ammonia to rice in this region. There was an indication that the sulphate of ammonia has a tendency to settle out. Also, the low spots in the field will, naturally, get more fertilizer than the higher spots on account of the water being at a greater depth. This was noticeable in this test.

Fertilizers Applied to Rice under Controlled Conditions: The results were different from those obtained in the field tests. Superphosphate is shown to be of much greater value to rice than the sulphate of ammonia when applied under these conditions. These results cannot be used for making recommendations for fertilizer treatment on rice under field conditions.

Sulphur Treatments on Rice: A study of the tolerance of rice plants to various degrees of acidity and alkalinity was started this season. Sulphur and lime were used in the tests conducted in cylinders, and sulphur only was used in field tests. The plants in the cylinders receiving the heaviest applications of sulphur grew much faster than any of the others during the first part of the season, but there was not a great amount of difference at the end of the season. The plants receiving lime were noticeably slow in growing during the early part of the season, but improved during the latter part of the season. The heaviest yields of grain were obtained from the sulphur treated cylinders. However, there was no noticeable difference except where lime was used. The yield was noticeably lower in these cylinders. The field treatments consisted of rates of 500, 1000, and 2000 pounds of sulphur per acre. The results were rather irregular, but the use of 500 or 1000 pounds of sulphur per acre did give some increase in yield of rice.

Rice Rotations: The rotations of rice and summer-fallow, and rice and Crotalaria spectabilis gave the largest yields this season. The plats grown to rice continuously produced very low yields as compared to the other rotations. This season's results show rather definitely that any of the four crops, crotalaria, sesbania, cotton, or soy beans, or summer fallow in rotation with rice is better practice than cropping the land continuously to rice.

R. H. Wyche and H. M. Beachell, B. P. I., U. S. D. A.

Field Crop Investigations

Cotton Varieties: Missdel 1-0539 produced 298 pounds of lint cotton per acre, which was the highest yield obtained from any of the twenty-one arieties. Kasch produced the lightest yield of 183 pounds of lint per acre. ebane 804-50, and Deltapine Reg. No. 32 were second and third with ields of 288 and 285 pounds of lint per acre, respectively. The three ighest yielding varieties, also, had the largest percentage of fruit maured and picked by the end of 141 days. The fact that the other varieties vere somewhat later in maturing may have resulted in more loss from nsect damage.

Corn Varieties: The yields in this test probably suffered from the light ainfall during May. However, the yields were larger than during several f the preceding years. White Tuxpan produced the heaviest yield of 25.1 ushels of shelled corn per acre. However, Golden June, Reese Drouth esister, and Mosby's Prolific produced yields of more than 24 bushels per cre. Twelve of the twenty-one varieties produced 20 bushels or more per cre. The lightest yield of 12.6 bushels was obtained from Yellow Surropper 37.

Forage and Pasture Crop Investigations

Winter Legumes: Subterranean clover, the heaviest yielding variety, roduced 45,600 pounds of green forage, and 10,543 pounds of air-dry forage er acre. Early Southern bur clover was next with 29,888 pounds of green, nd 7,173 pounds of air-dry forage per acre. Hairy and purple vetches, elilotus indica, and red clover, also, produced good yields of forage.

Summer Legumes: Stands were exceptionally good in this test this seaon, and the yields were higher than usual in most cases. Crotalaria specabilis produced 19.24 tons of green, and 4.29 tons of air-dry forage per acre. one of the other varieties produced such yields. Eight of the sixteen arieties produced more than ten tons of green forage per acre, and all arieties excepting Mung beans and Chinese Red cowpeas produced more han two tons of air-dry forage per acre.

Pasture Fertilization: The percentage of increases in most of the reatments was not as large as in 1936, but the yields of both treated and ntreated plats were larger than in 1936. The use of lime alone increased e yield 32 per cent. Superphosphate showed noticeably larger increases n yield than was obtained from either nitrate of soda or sulphate of mmonia. The largest increase of 101.10 per cent was obtained by the se of 80 pounds of sulphate of ammonia, 160 pounds superphosphate, nd 32 pounds of potash, with one ton of lime per acre. The most profitable eatments, probably, are the 160 pound application of superphosphate, or e ton of lime.

Horticultural Crops Investigations

Nematode Control Work: A number of fertilizer treatments were made n fig trees badly infested with nematodes. These treatments made the ast two years were not repeated, but observations were recorded. The festation at present indicates no noticeable amount of control. Also, the ields of fruit were not sufficient to be worth recording as some trees roduced no fruit.

Citrus: The Meyer lemons produced a fairly satisfactory crop of frui this season. This is the most promising of the citrus fruits tested at thi station. Being on its own root stock, which appears to be well adapted t the local soil conditions, makes it more desirable from the standpoint o cold resistance. The grafted trees will not come back as a rule after a sever freeze and produce fruit as quickly as the Meyer lemon. And while th other tree may be killed below the graft or bud and be lost entirely, th Meyer lemon will come out from the root.

Pears: The Hybrid pear, T. S. No. 7493, produced fair yields of frui again this season. The yield was decreased by the fruit being blown fron the trees by a windstorm before being fully matured.

Tung Oil: Trees on the station are making but very little growth Practically no fruit was produced on these trees. Some two or three tree produced one to three nuts each.

R. H. Wyche.

SUBSTATION NO. 5, TEMPLE

Substation No. 5 is located two miles south of Temple and one half mil west of the Temple-Taylor highway No 95. The latitude is 31° 3′ north, th longitude 97° 21′ west, and the elevation 660 feet above sea level. Th average annual rainfall over a period of 25 years, 1913 to 1937 inclusive, i 35.20 inches, while for 1937 it was 28.66 inches. During the 25-year perio an average of only 6.48 inches of rain fell in the months of June, July, an August. The rainfall for these months in 1937 was 6.32 inches. The 25 year average rainfall for the six-months period, May to October inclusive is 18.17 inches, while 11.88 inches fell during these months in 1937.

The Station consists of a total of approximately 647 acres of land, 10 acres of which are leased. The soil on the Station is typical of the Blacklan region and is predominantly of the Houston series. All land is in cultivation except that occupied by farmsteads, roads, ditches, and natural drainage ways. There are approximately 34 acres of pasture along Boggy Creek which is the major drainage way through the Station.

The purpose of this Station is to aid the development of the agricultur of the Blacklands, particularly through the solution of the major cro and soil problems of the region. The soils of the region that have bee well preserved are very fertile and are admirably adapted to cotton culture Many of the outstanding problems, however, have arisen through the exploitation of these soils in the excessive production of cotton. The objective of this Station are: the control of the cotton root rot disease; the preventio of soil erosion; the introduction, testing, and improvement of crop varieties the improvement of soil fertility; and the study of various cropping systems The cotton root rot problem is being studied by the Station under supervisio of the Division of Agronomy and the Division of Plant Pathology an Physiology of the Texas Agricultural Experiment Station with the co-operation of the Bureau of Plant Industry of the United States Departmen of Agriculture. The soil and water conservation problem of the area is being studied by the Soil Conservation Service of the United States Department of Agriculture in cooperation with the Station.

The needs for a rational farm program for the area to cope with the diminishing soil fertility, soil erosion, and cotton root rot, all point in a similar direction. Excessive culture of cotton must be avoided in order to preserve the soil and control cotton root rot. Small grains, sorghums, and other grass crops are not only immune from root rot, but if properly handled, may be used to prevent excessive erosion and to improve the soils. When these crops are marketed through desirable classes of livestock, their possibilities as erosion preventing and soil building crops as well as income producers are increased. Unfortunately the past research program of the Station did not include livestock experiments, but with the acquisition of additional land during 1936 it was proposed to correct this deficiency. During the year 1937 livestock projects to supplement cotton farming have been instituted.

Cotton Root Rot Investigations

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

Cotton Root Rot (Phymatotrichum omnivorum), a fungus disease which s known to attack the roots of nearly 2,000 wild and cultivated plants, is the object of intensive study at this Station. Grasses, grains, and other monocotyledonous plants that have been tested are characteristically immune. The disease is not only a limiting factor to cotton production in the Blackland region but seriously handicaps the use of most taprooted crops also. The present knowledge of the disease indicates that its principal means of spread are by live roots and sclerotia. Experiments thus far have shown the Phymatotrichum spores to be sterile. Keeping fields free of susceptible crops for periods of at least three years has proved, thus far, to be the most practical means of effectively reducing root rot in such areas. Investigations under way at the present time are: (1) effectiveness of various cropping systems, including clean fallows, in reducing the severity of the disease; (2) determining the effect of these same cropping systems on the increase or decrease in number and viability of sclerotia; (3) testing the resistance of field crop legumes and cotton; and (4) laboratory and greenhouse studies of the disease and causal fungus and host. Root rot on the Station farm and in most of the old cotton in Bell County was very severe in 1937, even more so than in the two previous years which were unusually wet years. There was a four-inch rain on July 9 and 10, followed by clear, hot weather. This probably accounted to a great extent for the arge amount of root rot.

Effect of Four-Year Rotations of Cotton, Oats, Sorghum, and Corn on Number and Viability of Sclerotia: Sampling for sclerotia by methods previously described was made on acres A-1, B-1, C-1, and D-1 again in 1937 similar to a sampling made in 1934. In 1934 an average of 4497 sclerotia were found per acre with a viability of 43.6 per cent. In the 1937 sampling only 1883 sclerotia were found per acre with a viability of 46.6 per cent. An adjoining check of a continuous cotton acre showed 10,500 sclerotia per acre, 66.3 per cent of which were viable. This is an average of two samplings from the check acre. In other words, at the last sampling there were 878 viable sclerotia per acre in the rotations as compared to 6959 in the continuous cotton acre. A duplicate four-year rotation on acres A-2, B-2, C-2, and D-2 showed an average of 4785 sclerotia per acre, 1855 or 38.8 per cent of which were viable. Each time that cotton has appeared on acre B-1 in this four-year rotation there has been twice as much root rot as on any of the other acres in different years. Both samplings of this acre have shown twice as many viable sclerotia as from any of the other acres. These figures represent the number of sclerotia in 320 six-inch post-hole samples to the 3-foot depth, or approximately 1/500 of the total soil volume to the 3-foot depth.

Effect of Different Two-Year Rotations on Number and Viability of Sclerotia: Soil samples for sclerotial analysis were taken from two-year rotations of cotton and oats, cotton and sorghum, cotton and corn, and cotton and guar. From the cotton-oats rotation 4118 sclerotia were found, 2112 or 51.3 per cent of which were viable. From the cotton-sorghum rotation 3244 sclerotia were found, 2514 or 59.2 per cent of which were viable. From the cotton-corn rotation 6458 sclerotia were found, 4760 or 73.7 per cent of which were liable, and from the cotton-guar rotation 7082 sclerotia were found, 4416 or 62.4 per cent of which were viable. From the adjoning check acre F-6 planted continuously to cotton, 18,200 sclerotia were found, 9957 or 54.7 per cent of which were viable. The larger amounts of sclerotia in the cotton-corn and the cotton guar rotations were to be expected. Although guar is listed as a relatively non-susceptible legume, about 10 per cent of the plants usually die. Inasmuch as guar plants have rather a large root system, this would be sufficient to replace quite a number of sclerotia in the soil. Corn crops always have some late summer susceptible weeds such as tievines and others.

Effect of Clean Fallow and Continuous Cotton Following Clean Fallow on the Number and Viability of Sclerotia: Part of acre E-6 on the Substation has been clean fallowed for seven years, part planted to cotton for four years following three years clean fallow, and part planted to cotton two years following five years clean fallow. Sampling for sclerotia during 1937 resulted in 12,488 sclerotia being found on the seven year clean fallow, 4111 or 32.9 per cent of which were viable. On the two-year cotton following five years clean fallow 5852 sclerotia were found, 3865 or 66 per cent of which were viable, and from four years cotton following three years clean fallow 3196 sclerotia were found, 2611 or 81.7 per cent of which were viable. These areas that have been planted to cotton after three years and five years clean fallow are much smaller than the area remaining in clean fallow at the present time, which might result in error as to the number of sclerotia found. However, the viability tests show that those areas in cotton longest have sclerotia with a much higher viability.

Effect of Continuous Sorghum on Number and Viability of Sclerotia: Acre H-2, part of which has been planted continuously to sorghum for three years and twelve rows of which has been planted to cotton for one year following two years sorghum, was sampled for sclerotia in 1937. The part planted to sorghum for three years showed 1197 sclerotia, 615 or 51.4 per cent of which were viable. One year cotton following two years sorghum showed 504 sclerotia, 364 or 72.2 per cent of which were viable. Sampling of such small areas as that planted to cotton in this case probably does not show an accurate estimate of the number of sclerotia.

Effect of Seven Years Clean Fallow on Root Rot and Yield of Cotton: Cotton planted on land on the Substation (acre E-6) kept in clean fallow for seven years yielded 1186 pounds seed cotton per acre and had 31.2 per cent root rot at the end of the season. Only 10.8 per cent of this cotton was killed by August 1. Cotton planted for the third year following five years clean fallow yielded 477 pounds seed cotton and had 93.5 per cent root rot. Cotton planted for five years continuously following three years clean fallow had 371 pounds seed cotton per acre and had 89.8 per cent root rot. The cotton planted for the first year after seven years fallow was large and rank in growth, fruiting rather heavily.

Effect of Continuous Sorghum on Root Rot: In 1937 cotton was planted for the second year following two years of continuous sorghum. There was an end-season root rot count of 96.4 per cent. As early as August 15, 91.1 per cent of this cotton was killed by root rot, resulting in low yield.

Residual Effect of Different Chemicals and Previous Crop on Cotton Yield and on Root Rot: On the one hundred seventy 1/200 acre plats treated with varying amounts of boric acid, cupric sulphate, iron sulphate, magnesium sulphate, manganese sulphate, and zinc sulphate, and with 1000 pounds of sulphur in 1936 and planted to cotton, Blackeye cowpeas, and Brabham cowpeas, cotton was planted in 1937 to determine the residual effects of these treatments and different crops on the yield of cotton and amount of root rot. There apparently was very little residual effect on root rot and cotton yields from the different chemicals with the exception of sulphur. The previous crop seemed to show some effect on cotton yields. The average of all check plots in the different series showed the following effects: cotton following Blackeye cowpeas yielded 1010 pounds seed cotton per acre and showed 38.0 per cent root rot; cotton following Brabham cowpeas yielded 457 pounds seed cotton and showed 88.0 per cent root rot; cotton following cotton yielded 308 pounds seed cotton and showed 88.8 per cent root rot. Cotton following Blackeye cowpeas plus 1000 pounds sulphur per acre yielded 620 pounds seed cotton per acre and showed 82.3 per cent root rot; cotton following Brabham cowpeas plus 1000 pounds sulphur yielded 684 pounds seed cotton and showed 82.3 per cent root rot; cotton following cotton plus 1000 pounds sulphur yielded 202 pounds seed cotton per acre and showed 92.8 per cent root rot.

Effect of Copper, Iron, and Mercury on Growth of Root Rot Fungus in Solution Cultures: Some of the laboratory work previously reported was repeated during the summer of 1937. The root rot fungus was grown in cultures containing copper, iron, and mercury in amounts varying from .2 to 50 parts per million. The same high toxicity of copper was found in concentrations above five to ten parts per million. No growth was obtained above ten parts per million of this element. Iron at fifty parts per million showed a much greater toxicity than mercury. There apparently was no toxic effect of mercury at fifty parts per million in solution containing starch. The fungus shows a much more vigorous growth in starchy solutions than in non-starchy solutions. Check cultures in solutions containing thirty grams starch per liter yielded 452 milligrams of fungus per 250 cc. flask, compared to 70 milligrams from checks containing no starch.

Analysis of Cotton Seed from Green Plants and from Plants Killed by Root Rot at Different Dates: Analyses of seed from green plants and from plants killed at different dates during the growing season were made in 1937 similar to those reported in 1936. In addition to oil and protein analyses, it was planned to make analyses of free fatty acid in oil. There were only two samples that had enough seed to make fatty acid determinations, it being rather difficult to secure enough seed from plants killed early in the growing season. Seed for free fatty acid determinations were secured from green plants and from plants killed late in the season, and as was to be expected, especially as the season was dry, there was no difference in the fatty acid content, the tests showing .2 per cent in each case. There was the expected variation in oil content of seed from plants killed early in the season and from plants killed late in the season or remaining green. This percentage varied from 10.14 per cent for seed from early root rot killed plants to 18.58 per cent for seed from plants remaining green at the end of the season.

Resistance Tests of Cowpeas and Cotton: Seed selected from last year's resistance test of cowpeas and cotton were planted in test plots this year. Cowpea selections are from the Iron and Brabham varieties, and the cotton selections are from Qualla cotton variety. These blocks were inoculated three times and irrigated four times during the season. Pieces of freshly infected cotton roots were placed about six feet apart against the plants in the drill at the first two inoculations and near all green plants in the last inoculation. Approximately 1400 pounds of seed cotton per acre was harvested from the test block of cotton because of the fact that it was irrigated. The greater part of the cowpeas remained green until after seed were produced. Seed from those plants remaining green have been harvested and will be planted next year.

C. H. Rogers.

Soil and Water Conservation Investigations

(In cooperation with the Soil Conservation Service, U. S. Department of Agriculture)

Soil and water conservation investigations at the Blackland Experiment Station, Temple, Texas, have been in progress since 1929. This work is applicable to the Blackland region of Texas and to parts of the Grand prairie. It is estimated on the basis of a reconnaissance erosion survey made in 1934 that out of a total of some 9,500,000 acres of crop land in the Blackland region more than 7,700,000 acres needed protection from erosion. The Grand prairie, lying to the west of the black prairie has climatic and certain soil conditions so comparable to the Blackland region that at least a part of the area may be considered as being served by this Station. Here and in the remaining area of the Blackland approximately 5,600,000 acres of grass land have been badly overgrazed, and resultant soil and water losses have seriously decreased the livestock carrying capacity. The total area served by this Station is approximately 15,000,000 acres.

General Control Plat Work: The size of the plats in this study will limit the application of certain results to being indicators by which soil and water conservation practice may be developed. The results from this study are briefly enumerated as follows:

1. Sod-forming grasses, such as Bermuda, and close growing cultivated crops, such as oats, sorghum, and Sudan, are very effective in reducing soil and water losses.

2. Severely eroded Houston black clay is less retentive of moisture than the original surface soils; it is only about one third as productive as the top soil, and this difference is increased during dry years.

3. On a 4 per cent slope Houston black clay soil a three-year rotation of cotton, corn, and oats reduced soil and water losses to about three-fifths that of continuous corn. This effect is due primarily to the control exhibited by oats when it occupies the land. The effect of the same rotation was not quite so great on a 2 per cent slope Houston black clay soil; the loss of soil from the rotation was about two thirds that of the continuous corn, and the water loss was four fifths.

4. From similarly treated plats on 2 and 4 per cent slope Houston black clay soil, the soil loss on 2 per cent slope is two fifths that from the 4 per cent slope.

5. Plats in a rotation of cotton, corn, and oats, with rows across the slope, lost one third as much soil and one half as much water as plats with rows up and down the slope.

Terrace Investigations: There are twenty terraces which are equipped for measuring soil and water losses as a means of determining the effect of different design characteristics, such as grade, vertical spacing, and lengths. Results to date indicate that:

1. Level terraces with closed ends cannot be used satisfactorily in this area on Houston black clay soils.

2. Level terraces with open ends have a tendency to drown out crops in the channel during wet years.

3. Level terraces with closed ends and four inch tile drains two feet under the terrace channel perform no better than closed-end level terraces on Houston black clay soils.

4. A terrace grade not greater than 3 inches per 100 feet is more satisfactory from a standpoint of both soil and water losses, with a variable grade being most effective.

5. Soil losses decrease with a decrease of vertical spacing.

6. A terrace length of about 2000 feet is probably the maximum that should be used for this area.

7. There is no optimum length of terrace from the standpoint of soil and water losses. A suitable outlet is the greatest determining factor in the length of terraces under 2000 feet.

8. Terrace outlets and outlet ditches must be protected; both structures and vegetation are being used successfully for this purpose.

Strip-Cropping Investigations: Experimental installations for this study are very limited at the present time. There are five plats devoted to strip-cropping studies. The effectiveness of contour strip-cropping in the conservation of soil and water is quite apparent. The loss from the strip-crop plat having the greatest loss was one eighth as much as that from a check plat with rows up and down the slope. From this maximum loss from strip-cropping to the minimum, the practice has shown to be eight to twenty-eight times more effective in conserving soil than continuous cotton with rows down slope.

Protection of Eroded Lands by Revegetation: About forty-six different species of grass are being propagated on the Station for this purpose. These propagating areas are fenced, and palatability rates are being made on the grasses. This study has not progressed to such a point that very conclusive statements can be made, but results indicate that there are a large number of native grasses and a number of introduced species that may be used profitably in the revegetation of eroded lands. In addition, a number of running type grasses have shown promise as vegetation for use in the control of terrace outlets.

H. O. Hill, Soil Cons. Serv., U. S. D. A.

Other Agronomic Studies

In the general crop and soil experiments conducted on the Station an attempt is made not only to furnish the basic information upon which the cotton root rot and soil and water conservation investigations are predicated but also to supplement these specialized studies in such a way as to complete a well balanced research program on crops and soils for the Blackland region. The work specifically treated in this section is only that part of the field work for which a progress report is justified at this time.

Cotton Variety Test: In the 1937 cotton variety test, Chapman Ranch Mebane, one of the many new varieties grown on the Station for the first time this year, led all varieties in production with a yield of 346 pounds lint cotton per acre. Harper ranked second with a yield of 345 pounds; Sunshine, third with 343 pounds; Mebane 804-50, fourth with a yield of 338 pounds lint cotton per acre; and Acala N28-5, Cliett, and Buckelew Bros. Mebane all tied for fifth place, each yielding 334 pounds. These were followed closely by Ferguson 406 and Lentz Acala with 333 pounds, respectively. Of the thirty-six varieties tested this year, twenty-two varieties yielded 300 pounds and better of lint cotton per acre.

Acala (Rogers) and Watson, two varieties which have had the highest average yields for the past few years, ranked close to the lowest for all varieties in 1937 with 291 and 288 pounds respectively. Olander Mebane ranked lowest of all varieties with only 281 pounds of lint cotton per acre.

As to ginning percentage, Half and Half ranked highest of all varieties with an average of 42.8 per cent lint. This was closely followed by Cliett, Kasch (Ed), and A. D. Mebane Cotton Seed Co. strain of Mebane, with respective ginning percentages of 40.5 per cent, 40.2 per cent, and 40.1 per cent. Harper, Qualla, Bagley, and Texas Special tied for fifth place with an average of 39.6 per cent. A total of twenty-seven varieties were found to have ginning percentages above 37.0 per cent, with nine falling below that level. Sunshine ranked lowest of all varieties with 32.7 per cent lint.

As to size of bolls, the leading variety was Lankart, which showed the average boll size of 7.25 grams. This was followed in order by Chapman Ranch Mebane with boll size of 6.82 grams; Bagley, 6.79 grams; Paris Big Boll, 6.75 grams; and A. D. Mebane strain of Mebane, 6.71 grams. A total of nineteen varieties showed an average boll size of above 6.00 grams, while seventeen varieties fell below 6.00 grams. The lowest ranking variety in this respect was Mebane 804-50, which showed a boll size of only 4.63 grams.

A total of twenty-two varieties showed staple length of one inch and longer this year, four varieties having staple 1-1/16 inch long. These four were Rogers Acala, Lone Star 26, New Mexico College Strain of Acala, and Shafter Acala. Following these, came Wacona, Lentz Acala, Acala N28-5, Texas Mammoth, Buckelew Bros. Mebane, and Paymaster, all with staple length of 1-1/32 inch. Fourteen varieties had a staple shorter than one inch in length, and of these Half and Half took lowest rank with staple only 7/8 inch in length. This is unusually long staple for Half and Half, since its average for the period of years has been 26/32 inch.

As to earliness based on the percentage of total crop picked within a period of 129 days from planting date, Acala N28-5 ranked first, with 91.1

per cent. This was followed by Mebane 804-50 with 87.7 per cent; Half and Half, third with 87.3 per cent; and Paymaster fourth, with 87.1 per cent. Of the thirty-six varieties tested thirty-one varieties indicated an early maturing character with 75 per cent or more of the total production being matured and harvested within the 129 day period. Lankart was apparently the latest maturing variety tested, since only 69 per cent was picked within the 129 day period.

In a survey of the yields of the cotton varieties over the ten-year period of the test (1928-37), eleven varieties which have been grown each year are taken as the standards, and an average of their yields for the entire period is used as a basis on which comparable yields for all other varieties have been computed. The average yield of all standard varieties for the ten-year period is 268 pounds lint per acre, and the average yields for the standards for the individual years in the order of magnitude are as follows: 367 pounds, 1933; 320 pounds, 1931; 316 pounds, 1937; 275 pounds, 1936; 261 pounds, 1932 and 1928 respectively; 258 pounds, 1935; 235 pounds, 1934; 234 pounds, 1930, and 156 pounds, 1929. Thus it is seen that the average standard yield for 1937 was surpassed by only two other years, 1933 and 1931.

In addition to the eleven varieties mentioned, seventy other strains and varieties have been included in this test for periods of less than ten years. The highest ranking of these was Watson, which has been grown five years and has an average comparable yield of 316 pounds. Acala No. 111 (Rogers), grown from 1931 to 1937 inclusive, ranked second with a comparable average yield of 314 pounds lint cotton per acre. Three other varieties also surpassed the highest ranking standard variety with comparable yields as follows: Qualla (1st Year), grown in 1933, 307 pounds; Mebane (Chapman Ranch), grown in 1937, 293 pounds; and Anton, grown in 1929, 287 pounds lint cotton per acre. The fact that these varieties have been grown only one year, however, robs their yields of the significance they would acquire from being tested over a longer period of time.

Of the total number of varieties tested, fifty have comparable average yields of 250 pounds lint per acre or more, while thirty-one varieties fall below that figure. The lowest yielding variety is Summerour's New Strain, grown in 1932, with a comparable yield of only 118 pounds lint per acre.

Corn Variety Test: In 1937 sixteen different varieties were tested for productiveness in the corn variety test. The highest yielding corn variety in the test this year was Reese's Drouth Resister, which yielded 39.4 bushels shelled grain per acre. The second ranking variety was Nelson's Native Yellow with a yield of 37.0 bushels. This was followed by Ferguson's Surcropper with an average of 36.5 bushels, Nelson Native White, 36.4 bushels, and Dwarf Mexican June with 35.8 bushels. Yellow Surcropper with seed from three different years, 1935, 1936, and 1937, was grown, the yields of these respective years' seed being as follows: 35.9 bushels, 33.2 bushels, and 36.2 bushels. The average of the three Yellow Surcroppers was 35.1 bushels.

Of the sixteen different varieties, six averaged above 35 bushels of shelled corn per acre, while ten fell below this average. The lowest ranking variety was Pfluger's Mammoth Drouth Resister, which gave only 30.1 bushels per acre.

The highest shelling per cent was found in Yellow Surcropper 1936 which averaged 84.4 per cent grain. This was followed by Yellow Surcropper 1935, which shelled out 84.0 per cent. Yellow Surcropper 1937 and Pfluger's Mammoth Yellow Drouth Resister both gave shelling rate of 83.3 per cent. The lowest ranking variety in respect to per cent grain was Leudtke's Yellow Sure which had only 78.8 per cent grain after shelling.

During the ten years of the test, 1928 to 1937, five varieties have been planted each year. These five varieties are taken as the standard varieties, and the average yield of all five is used as a basis on which to rate such other corn varieties as have not been grown each year. The average yield of the standard varieties for the entire ten-year period is 31.6 bushels. The yield for 1936 was the highest and for 1934 the lowest during the period. The average for 1937 was 34.6 bushels, or three bushels above the period of years average for the standard varieties, although there were no unusually high yields for the specific varieties this year.

On the basis of the yield of the standard varieties, nine individual varieties have comparable yields for the entire test period exceeding the average of the standards. Reese's Drouth Resister, Ferguson's Surcropper, and Ferguson's Yellow Dent, three standard varieties, have comparable yields of 33.0, 32.9, and 31.9 bushels per acre, respectively. Red June and Leudtke's Yellow Sure, which have been grown five years, have comparable average yields of 32.4 and 31.8 bushels, and Nelson's Native Yellow, on the basis of three years planting, averaged 33.3 bushels per acre in comparison to the standard varieties' average of 31.6 bushels. The other varieties which exceeded the average of the standards have been grown only one year, and are as follows: Synthetic Surcropper, 33.5 bushels; Blankenmeyer's White Dent, 33.4 bushels; and Nelson's Native White, 33.2 bushels. The lowest comparable yield for the period, 16.8 bushels, was produced by Hickory King, a variety which was grown only one year (1935).

Hybrid Strain Test of Corn: Of the forty-eight selections of hybrid corn tested in 1937, the crosses with Yellow Surcropper as the male parent were generally more productive than either the Surcropper selections or the crosses with Yellow Surcropper as the female parent. Seventeen of the twenty-one strains in which Yellow Surcropper was used as the male parent surpassed all other selections in yield. Yellow Surcropper x 171A gave the highest production for the year with an average of 53.7 bushels shelled corn per acre, and this was closely followed by Yellow Surcropper x 123B, which averaged 53.1 bushels. Only two other strains yielded more than 50 bushels per acre, these being: Yellow Surcropper x 152C with 52.7 bushels, and Yellow Surcropper x 132A with 51.5 bushels. Worm damage for these four leading selections ranged from 52.9 per cent damage for Yellow Surcropper x 171A to 61 per cent for Yellow Surcropper x 132A.

The highest yielding cross with Yellow Surcropper as the female parent was 9665-110 x Yellow Surcropper, which produced an average of 41.0 bushels shelled corn per acre.

The lowest yielding strain for the year was 9665-53 x Yellow Surcropper with an average yield of only 24.8 bushels shelled grain per acre and an accompanying worm damage of 77.8 per cent.

The greatest worm damage was sustained by 9665-40 x Yellow Surcropper, which showed 90.8 per cent damage with the correspondingly low yield of 32.1 bushels grain. The lowest worm damage was found in Yellow Surcropper x 139A, which suffered 44 per cent damage with a yield of 47.2 bushels.

A study of hybrid corn has been made at this Station for a period of three years, 1935 to 1937 inclusive. The same strains, however, have not been grown each year. For purposes of comparison, therefore, in 1935 and 1936 four commercial varieties were planted in the test as checks or standard varieties, the average of the four being taken as the basis for rating the hybrids. These varieties were Gorham Yellow Dent, Ferguson Yellow Dent, Surcropper, and Mexican June. In 1937 these standard varieties were omitted from the test, thus making it impossible to get a base or standard for purposes of comparing yields for 1937 with those for the preceding years.

On the basis of actual yields, the most productive strain tested during the entire period of the test was Yellow Surcropper x 171A with a yield of 53.7 bushels shelled corn per acre in 1937, the only year it has been grown. Three other selections grown in 1937 produced over 50 bushels per acre, and two strains grown in 1935, 14A x Gorham and 133E x Thomas, also gave yields of over 50 bushels per acre.

The worm damage on these five most productive strains ranged from 48.8 per cent to 61 per cent damage. The lowest yielding strain ever grown in the test was 121B-4 x Gorham, grown in 1936, which had an average production of only 20 bushels shelled corn per acre. The amount of worm damage in 1936 was generally lower than for either 1935 or 1937, but the yields, instead of being correspondingly higher, were generally much lower than the yields of the other two years.

Small Grain Rust Resistance Test: The small grain improvement work conducted at the Temple Station in 1937 consisted of testing the yields of various strains of rust resistance wheat and oats. A total of 44 different strains of oats were tested together with a total of 44 strains of wheat.

Based on actual average yields four of the oats selections tested in 1937 yielded over 70 bushels per acre. Lee x Victoria (Ark x 2-25) yielded 74.47 bushels. Nortex x Victoria M19-35, 71.52 bushels; Nortex x

Victoria M19-53, 70.98 bushels; and Lee x Victoria M15-1 yielded 70.40 bushels. Out of the 44 strains tested, 21 averaged over 60 bushels per acre while only two strains fell below an average of 50 bushels. The average of all checks of Nortex was 68.96 bushels grain per acre.

On the basis of actual average yields, the leading strains of rust resistant wheat tested in 1937 was variety Selection No. 41-121, which had an average rate of production of 31.9 bushels grain per acre. This was closely followed by Selection No. 41-16-3-3 with an average yield of 30.5 bushels per acre. A total of 13 wheat selections averaged 25 bushels or more per acre. The leading wheat selection grown in 1936, Selection No. 41-17-3, was not grown this year, but the second ranking strain from 1936, Selection No. 41-16-1-1 fell far below its last year's average of 31.8 bushels and produced only 24.8 bushels. The lowest producing strain tested was Medt. 63 with an average yield of only 14.9 bushels grain per acre. The check variety selection, 41-Bulk, averaged 24.1 bushels per acre.

Grain Sorghum Variety Test: The sorghum variety test for 1937 was composed of six leading grain sorghum varieties for the Blackland region and three of the most promising sweet sorghums, including African Millet. Darso ranked first in yield of grain with 41.7 bushels threshed grain per acre, while Schrock ranked second with 37.6 bushels. Leoti, a new sorgo crop grown at this Station for the past two years, seems to be a very promising crop, as it affords production in three ways, namely, grain, forage, and syrup making. However, in 1937 Leoti made the lowest grain yield in the test, production being only 27.3 bushels per acre. Darso ranked first in forage production with a total of 4.34 tons dry forage per acre, making this the most outstanding variety grown in 1937.

For the ten-year period of the test (1928-37) the three highest grain yielding varieties were as follows: Darso, 29.3; Chiltex, 26.7; and Schrock, 24.7 bushels of threshed grain per acre. During the same ten years, these varieties produced an average of 3.51, 2.38, and 3.65 tons of dry forage per acre respectively. For the ten-year period Hegari made the lowest yield in grain of all varieties with only 16.8 bushels per acre. Chiltex made the lowest yield in forage production with only 2.38 tons dry forage per acre.

For the four-year period, 1934 to 1937 inclusive, the four varieties of sorghum grown for both forage and grain production yielded as follows in order of rank on a comparable basis: African Millet, 4.99; Sumac, 4.18; Leoti, 4.08; and Ajax, 2.56 tons of dry forage per acre. In grain production these four varieties ranked as follows on the basis of comparable yields: Leoti, 24.0 bushels; Ajax, 23.7 bushels; Sumac, 18.1 bushels; and African Millet, 16.4 bushels threshed grain per acre.

Legume Variety Test: Twenty-two varieties were grown in the winter legume test and twenty-two varieties were also tested in the spring planting. The highest forage yield for the year in the winter legume test was obtained from Hubam Clover, which had an average from all four plats of 3690 pounds dry forage per acre. This yield is only slightly more than half the yield of the same variety in the 1936 test of 6890 pounds dry forage per acre. The second highest yielding variety this year was Italian Rye Grass with 3068 pounds, and the third ranking variety in production of dry forage was Early Southern Bur Clover with 2895 pounds.

The lowest yielding variety for the year, with the exception of four varieties which made complete failures, was found to be Purple Vetch, which had an average yield of only 70 pounds dry forage per acre.

The effects of inoculation were not evident in the results of the winter test as measured by forage yield, since in eight of the sixteen inoculated varieties for which yields were recorded the uninoculated plats exceeded the inoculated plats in yield.

Many of the varieties in the winter test failed to make seed. The highest seed yield for the year was made by Hubam Clover, which produced at the rate of 780 pounds threshed seed per acre. This was followed by Rescue Grass with an average of 600 pounds threshed seed per acre. The lowest seed yield recorded, with the exception of the complete failures, was for Alsike Clover, which produced 270 pounds seed per acre.

The dry forage yields in the spring legume test for 1937 failed to approach the yields of the 1936 test. Guar was again outstanding with a yield of 3120 pounds dry forage per acre on inoculated plats and 2400 pounds per acre on uninoculated, an average for all plats of 2960 pounds per acre of dry forage. Sesbania did not show the great productiveness which made it the leading variety in the test for 1936, its yield for the year being only 1680 pounds forage on inoculated plats and 1650 pounds on uninoculated plats, an average of 1670 pounds dry forage per acre for all plats. Biloxi Soybeans had the second ranking yield for the year, this variety producing at the rate of 1740 pounds per acre on the inoculated plats and 3030 pounds on the uninoculated plats, or an average for all replications of 2600 pounds per acre.

Because of excessive shattering of some varieties and failure to make seed in other varieties, only two yields for seed production could be secured: Mungbean produced 330 pounds seed per acre, while Chinese Red Cowpeas produced at the rate of 390 pounds seeds per acre.

The following legumes seem to show considerable promise for this section: Hubam, Iron and Brabham Cowpeas, Guar, and Sesbania. The two latter varieties have shown the greatest development in forming nitrogen nodules on the roots and also have shown some resistance to root rot.

Cropping Systems

In 1937 eight different rotations were studied at this Station, four being three-year rotations and four being two-year rotations. Each of these cropping systems has been in practice for the ten-year period 1928 to 1937 inclusive.

Cotton in Rotations: Cotton appears in all rotations under study. The highest cotton yield for the year in the series of rotations was secured from a two-year rotation of cotton and corn, which produced at the average rate of 464 pounds lint cotton per acre, as compared to the average yield of 174 pounds lint cotton per acre on the continuous check acre.

In the period of years survey for 1928 to 1937 inclusive the results of the rotations as to cotton production show the rotation of cotton-corn ranking first with an average of 278 pounds. It was followed by the cotton-guar rotation with 274 pounds. Of the four three-year rotations, the rotation consisting of cotton-sorghum-oats led with a production of 267 pounds lint per acre for the ten-year period. The rotation consisting of cotton-cotton-oats showed the lowest average yield of 192 pounds for the period of years for all rotations.

Corn in Rotations: Corn appears in two rotations on the Station farm. In 1937 the cotton-corn-oats rotation produced an average of 32.4 bushels of shelled corn per acre. The two-year rotation of cotton-corn was much more productive, the average being 48.0 bushels of shelled corn per acre as compared to the average yield for continuous corn plats of 33.4 bushels.

A survey of the test over the complete period of the rotations reveals that the three-year rotation of cotton-corn-oats has yielded less corn than the two-year rotation of cotton-corn in eight of the ten years of the test. The average for the three-year rotation was 28.0 bushels for the period of years 1928 to 1937, as compared to 34.5 bushels shelled corn per acre for the two-year rotation. The average of the continuous corn plats for the same period of years was 27.0 bushels.

Sorghum in Rotations: Sorghum was grown in a rotation of cotton-sorghum-oats and in a rotation of cotton-sorghum. In 1937 sorghum in the three-year rotation produced 52.08 bushels grain as compared to the yield of 25.34 bushels threshed grain per acre for the two-year rotation. The continuous sorghum plats on the check acre produced an average yield of 14.97 bushels threshed grain per acre. As to forage, the three-year rotation yielded an average of 3.87 tons dry forage per acre as compared to 2.10 tons from the two-year rotation. The permanent checks or continuous sorghum plats produced an average of 1.37 tons dry forage in 1937.

A survey of the grain yields for the period 1928 to 1937 reveals that the three-year rotation of cotton-sorghum-oats has consistently produced more abundantly than either the two-year rotation or the permanent check. The ten-year average yield in grain of the cotton-sorghum-oats rotation was 34.8 bushels per acre; the average of the cotton-sorghum rotation was 29.8 bushels; and the average of the check plats was 22.6 bushels threshed grain per acre. The ten-year average dry forage yield for the three-year rotation was 3.28 tons as compared to 2.73 tons dry forage per acre for the two-year rotation. The average dry forage production for the continuous sorghum plats in the permenent check acre for the period of years was 2.62 tons per acre, which is lower than the yield for either of the rotations.

Oats in Rotation: Oats was grown in three three-year rotations and in one two-year rotation. In 1937 the rotation of cotton-cotton-oats produced an average of 47 bushels threshed grain per acre as compared to 44.4 bushels for the two-year rotation of cotton-oats, 44.0 bushels for the three-year rotation of cotton-corn-oats, and 40.8 bushels for the three-year rotation of cotton-sorghum-oats. The two-year rotation of cotton-oats led in straw production with an average of 1.18 tons straw per acre. The rotation of cotton-sorghum-oats produced the lowest yield of straw with an average of only .96 ton per acre. The permanent checks of oats yielded an average of 43.5 bushels grain and 1.24 tons straw per acre.

In the period of years (1928-37) the rotation of cotton-cotton-oats produced more grain and straw than any other rotation, the average yield per acre being 42.1 bushels grain and 1.34 tons straw. The rotation cotton-corn-oats was the least productive over the ten-year period, with an average yield per acre of 34.4 bushels grain and 1.03 tons straw. The period of years average for the permanent oats checks was 36.3 bushels grain and 1.34 tons straw per acre.

C. H. McDowell.

Plant Introductions: A total of 221 plants comprising 26 different species were received from the Division of Plant Exploration and Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C., in the spring of 1937, for testing at Substation No. 5. Part of these plants were immediately planted in the nursery and part in the greenhouse. There was a short period of cold weather following transplanting which might in part account for the low survival. On November 12, 1937, there were 101 plants comprising 20 species surviving.

C. H. Rogers.

Miscellaneous Diseases: Bacterial blight *(Bacterium malvacearum* EFS) caused considerable damage to cotton this year in Bell and adjacent counties. The infestation on seedlings and leaves of mature plants was less than last year, but boll and lint damage was higher. Other boll rots, identified as Aspergillus and Macrosporium, were found. Mildew on crape myrtle, lilac, zinnia, and a few other ornamental and vegetable crops was severe in the late spring. Infestation of smut on sorghum, particularly the Red-top variety, was higher this year during June and July than has been observed in previous years. Because of the exceptionally dry season, chlorosis was severe on certain ornamental and vegetable crops. A list of plant diseases has been compiled for the Plant Disease Survey.

Insect Pests: Cotton insects were more numerous as to different kinds during the 1937 season than in any recent year. Flea hopper infestation began early and continued until late fall primarily because of the large amount of late June planted cotton. Boll weevils were plentiful and damage was rather high, especially after the rains of July 9 and 10 and in the late fall on late cotton. Alfalfa web-worms defoliated almost all of two fields of young cotton in the early season. The cotton square borer was also found doing considerable damage in two or three instances. Early infestations of fleas in and around households in Temple were unusually severe during the summer and early fall. Complaints were received and calls made where infestations of bag worm, snails, peach borers, pecan borers, shot-hole borers, sow bugs, and other common insects were found.

C. H. Rogers.

Livestock

In October, 1937, a small flock of sheep consisting of approximately 150 head of grade Range Rambouillet ewes were purchased from near Sonora, Texas, to utilize the 34 acres of pasture land bordering on Boggy Creek. Adjacent to the pasture on rolling land, winter oats have furnished abundance of green grazing through the months of November and December. This flock of sheep will be continued throughout the summer on the 34 acres of pasture and records will be kept as to the relaitve amount of income derived from pasture land which in previous years has not returned any revenue. This work comes under the classification of land utilization in the Soil and Water Conservation and Land Use Project of the Soil Conservation Service of the U. S. Department of Agriculture and the State Experiment Station cooperating. At a future date it is anticipated to add cattle and hogs to the livestock program at this Station.

C. H. McDowell.

SUBSTATION NO. 6, DENTON

Substation No. 6, five and one-half miles northwest of Denton, is 600 feet above sea level. The average annual rainfall for a period of 23 years is 32.86 inches, 20 per cent falling in December, January, February; 32 per cent in March, April, May; 24 per cent in June, July, August; and 24 per cent in September, October and November. The average dates of the last killing frost in the spring and the first in the fall are March 24 and November 12, respectively. This station is in the important wheat and oat producing area of North Texas. The predominating soils are clays of the San Saba and Denton series, which are typically developed on the Fort Worth Prairie, the northern part of the Grand Prairie Region. The Station comprises an area of 209.92 acres.

The primary objects of this Station are the improvement of small grains adapted to the wheat- and oat-growing region of North Texas, and the development and improvement of other crops for this region. Field crops, such as cotton, corn, and grain sorghums are included in the experiments at this Station. Plant introduction tests, with particular emphasis on legumes for use as pasture and soil-improvement crops, are an important part of the program of this Station.

Small Grain Investigations

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

The small grain work of the station is carried on at two locations. Extensive work with wheat, oats, and barley is carried on at the Substation to improve these crops for North Texas conditions. In addition, improvement work with hard winter wheat is carried on in the Texas Panhandle through the cooperation of farmers and county agents in that section, and through the cooperation of the Amarillo Chamber of Commerce a breeding nursery is grown at that point.

Wheat Investigations: Experimental work with wheat at the Denton Substation comprises varietal tests of new strains in comparison with adapted standard varieties; extensive nursery tests of varieties compared with newly developed strains, and regional studies of varieties; extensive breeding nurseries where new strains are developed by hybridization and selection; regional and local studies of leaf and stem rust; studies of smut resistance; shattering; lodging; and quality for flour and pastry purposes.

The 1937 season was unusualy favorable in many respects for wheat production and as a result a very fine crop of good quality grain was produced. Fall weather conditions were favorable for planting and establishment of the crop. A severe spring drought, during April and May, caused some damage to small grain but wheat matured fairly well in spite of the dry weather. No rust of importance developed until very late in the season.

The field plat wheat variety test consisted of 19 varieties of hard and soft winter wheat. Because it escaped the spring drought, the early maturing variety, Early Blackhull, produced the highest yield averaging 47.6 bushels per acre. Other high ranking varieties were Tenmarq 45.0 bushels, Quivira 44.1 bushels, and Blackhull 42.6 bushels. The season favored the hard winter wheats because of dry weather and little rust. Leading soft winter wheat varieties were Campbell Mediterranean 40.3 bushels, Kawvale 39.1 bushels, and Clarkan 39.0 bushels per acre.

In the period of years summary from 1928 to 1937 inclusive, Quivira has been grown seven years and has produced the highest comparable yield, averaging 32.8 bushels per acre. Tenmarq has been grown nine years and has a comparable yield of 31.9 bushels per acre. Clarkan is the most promising new soft winter wheat variety. It has been grown only three years but has a comparable yield of 29.5 bushsls. Comparable yields of Kawvale, Kanred, Blackhull, Denton, and Mediterranean 3015-81 grown the full ten-year period are 28.6, 28.4, 27.5, 27.3, and 25.9 respectively. The relatively high yields of the hard winter wheats in 1936 and 1937 account for the high rank of Kanred and Blackhull.

Nursery tests: Two main testing nurseries, varying principally in size of plat, are grown. The advanced nursery consists of 97 varieties grown in 3-row 16 foot plats, arranged in a modified Latin Square in four replications. Included in this nursery are new strains developed in preliminary nurseries, regional nursery tests of varieties, and more or less standard varieties for comparison. More than half the strains in this nursery were newly developed strains being tested for the first time in replicated plats. The leading strians were Kawvale x Tenmarq C. I. 11821, 35.4 bushels per acre; Denton x Kanred, 4-33-28, 35.2 bushels; Kawvale x Tenmarq 35-34-96, 34.3 bushels; Denton x Kanred, 4-33-7, 34.1 bushels; Oro x Tenmarq, C. I. 11673, 33.7 bushels; Red May Selection 7250-1, 33.2 bushels; Martin x Tenmarq 50-33-60, 33.0 bushels; Martin x Tenmarq 50-33-63, C. I. 11805, 32.9 bushels; Kanred x Kawvale, J34603, 32.5 bushels; and Martin x Tenmarq 50-33-23, C. I. 11804, 31.7 bushels. Tenmarq and Denton wheats in the same tests averaged 28.4 and 25.3 bushels per acre respectively. All of these leading strains except those ranking first, fifth, and ninth were developed at this Substation and have other desirable qualities in addition to their yielding ability. The Martin x Tenmarq strains are all resistant to stinking smut, while several others are resistant to leaf rust, and partially resistant to stem rust.

The preliminary nursery was enlarged this season with respect to number of strains tested and number of replications. The size of the plat was reduced to a 2-row 8 foot plat, the entire plat being harvested. Approximately 200 strains were tested in four replications. This permitted testing, in a fairly accurate way, many new strains from head rows and previous preliminary nurseries. Some very promising new strains were isolated for further testing.

Breeding work consisted of testing more than 1300 new selections in head rows, and growing a large number of bulk hybrids from which further selections were made. Some twenty-five new hybrids were made this season in an attempt to combine the rust resistance of the new Mediterranean x Hope hybrid strains with desirable qualities such as resistance to smut, drought, and loose smut, etc., of other varieties.

Diseases of wheat: The two principal diseases which attack wheat in north central Texas are leaf rust and stem rust. Uniform U. S. Department of Agriculture spring and winter wheat disease nurseries were grown in a study of the occurrence and spread of these diseases. Notes on the resistance or susceptibility of all strains grown in the Denton nurseries were taken although the amount of rust this season was rather small and appeared late in the season. An epidemic of stem rust was induced by means of spreader rows in certain portions of the nursery where resistant hybrid strains were grown in order to get better information on their resistance. The development of stem and leaf rust resistant strains of wheat is the major problem at this station because of spread of rust from this section to other wheat growing areas of the United States.

In a cooperative regional study of stinking smut or bunt of wheat, a disease nursery, where varieties are tested for resistance to smut, was grown. Included in this nursery were three strains, namely, Martin x Tenmarq 50-33-23, C. I. 11804; Martin x Tenmarq 50-33-63, C. I. 11805; and Kanred x Oro, 18-33-32, C. I. 11803, which were developed at this station. These strains ranked fifth, ninth, and sixth respectively among the fifty strains tested averaging only 0.8, 1.0, and 1.6 per cent smut while susceptible varieties averaged as high as 59.3 per cent smut. The first two of these varieties were among the high ten leading strains in yield at Denton this season.

Loose smut of wheat has become an increasingly important disease in central Texas in the last few years. Methods have now been devised whereby artificial infection can be produced to test the resistance of varieties to this disease. More than 100 varieties and strains were tested this season, but as infection must take place one year and the disease appear the following year, the results will not be determined until next year. Varieties known to be resistant to loose smut were obtained from other experiment stations this year and these were crossed on adapted varieties to produce new adapted strains resistant to smut.

Cooperative wheat variety tests: From ten to sixteen varieties were tested in cooperative variety tests in the Texas Panhandle again this season. The season was so extremely dry that wheat was a failure over much of the area. Data were obtained only at Amarillo and at Spearman, Texas. The variety test at Amarillo was irrigated in March and produced fair yields. The leading varieties at Amarillo under irrigation were Chiefkan, Quivira, Kharkof, and Cheyenne. At Spearman, under very adverse conditions with yields below 5.0 bushels per acre, the leading varieties were Kharkof, Cheyenne, and Turkey, with Chiefkan almost a complete failure. Tests over a period of seven years show that the best varieties for that section are Tenmarq, Cheyenne, Blackhull, and Kharkof.

A cooperative soft winter wheat variety test at U. S. Cotton Breeding Station, Greenville, Texas, was grown. Leading varieties in yield were Tenmarq, Fultz, Clarkan, and Denton. Tests of milling qualities of wheat grown at Greenville in 1936 showed it to be too high in protein for good pastry flour, but all varieties produced good commercial flour.

Laboratory studies being conducted at this time consist of detailed studies of strength of straw as related to lodging and shattering of wheat. Varietal surveys, studies of plant characters related to these factors, and inheritance studies are being conducted.

Oat Investigations: Oat investigations, while not quite as extensive as those of wheat are conducted in a similar manner. Experiments consist of varietal tests of both fall and spring seeding; replicated, advanced, and preliminary nurseries of both fall and spring seeding; disease resistance studies; and winter-hardiness studies.

Eleven varieties were tested from fall and spring seeding in field plats. High yields of good quality grain were produced in the fall sown test. The leading varieties were New Nortex and Texas Red Rustproof 1415-12, producing 84.3 and 86.1 bushels per acre. All strains grown were of the Red Texas type and difference in yield were small. For the nine years that yields have been obtained in the period 1925 to 1937, the leading varieties are Texas Red Rustproof 1415-12 and New Nortex. Texas Red Rustproof 1415-12, grown only four years has averaged 76.9 bushels per acre.

New Nortex, grown nine years, has averaged 75.5 bushels. Nortex for the same period has averaged 71.6 bushels, and Ferguson 922 has averaged 67.8 bushels. New Nortex was distributed to farmers for the first time in 1937.

From spring seeding oats produced light grain, although the yields were fairly good. Leading varieties were Frazier 64.3 bushels per acre, Nortex 60.3 bushels, and Texas Red Rustproof 1415-12 56.5 bushels per acre. Leading varieties over the nine year period, 1929 to 1937, are Texas Red Rustproof 1415-12, comparable yield 79.7, grown 6 years; New Nortex, comparable yield, 77.7, grown eight years; Texas Red Rustproof 1118-69 comparable yield 77.2, grown nine years; Nortex, Frazier, and Ferguson 922 for the same period have produced 73.5, 67.9, and 77.0 bushels respectively.

Nursery tests: Forty varieties and strains were grown from both fall and spring seeding in replicated 3-row plats of the advanced nursery. The standard varieties included in the field plat test were also included in this test along with newly developed strains. From fall seeding some winter-killing of new strains resulted, while other new strains survived equally as well as the standard varieties. Leading varieties in yield were New Nortex, Texas Red Rustproof 1415-12, and Nortex with yields of 99.2, 94.0, and 93.8 bushels per acre. Several of the new rust and smut resistant strains were among the ten high yielding strains and are promising. From spring seeding yields were much lower and quality poorer. Leading varieties in yield were New Nortex, Nortex, Fulghum x Victoria 12-33-60, 12-34-53, and 12-33-90 with yields of 79.6, 71.2, 70.4, 69.6, and 68.4 bushels per acre. For the period of years, Nortex is the leading variety from both fall and spring seeding followed closely by New Nortex, Texas Red Rustproof 1118-69, and Ferguson 922.

Preliminary oat nurseries were made up of about 60 strains from fall seeding and approximately 200 strains from spring seeding. These strains were in most instances new hybrid strains selected for resistance to rust or smut. Some of these were very promising in yield as compared with standard varieties used as checks. Over 900 selections made in 1936 were grown in head rows and numerous hybrids were grown for selection purposes.

Uniform regional nurseries for the study of the occurrence and spread of rust and smut were grown. Artificial epidemics of stem and leaf rust were attempted in the breeding nursery, so that more resistant selections could be made. As the season was very dry, the rust did not spread and no epidemic was obtained. All strains grown in advanced nurseries were tested for resistance to smut. Winter-hardiness studies were continued on winter oats in cooperation with other experiment stations.

Barley Investigations: Ten varieties of barley were seeded in the replicated field plat test. The season was very favorable for barley and high yields of good quality grain were produced. The very high yield of 63.6

bushels per acre was made by Smith S-31-62 barley. Second in yield was Bailey barley yielding 55.1 bushels or 8.5 bushels less. Finley, a variety distributed by the station several years previously, yielded 45.5, and Tennessee Winter 15826 yielded 44.7 bushels per acre. For the average of the past three years Smith S-31-62 barley has yielded 45.5 bushels per acre or 33.1 per cent above the average of five standard varieties. This strain is being increased for distribution to farmers.

In a replicated advanced nursery test forty varieties and strains of winter barley were grown. The new hybrid strains having smooth awns, namely Harlan Hybrid 1-33-7 and 1-33-179, produced the very high yields of 75.0 and 70.3 bushels per acre in comparison with a yield of 65.3 bushels for Smith S-31-62 and 56.7 for Finley. These strains also yielded well in 1936, although not as outstanding as this season. Over a period of years Smith S-31-62 ranks highest in yield, having a comparable yield of 45.0 bushels per acre, or 33.0 per cent of the standard varieties with which it is compared. In a replicated preliminary nursery some sixty additional new hybrid strains were tested. Some of these strains also have smooth awns and are considered quite promising. Bulk hybrids and head selections were grown for future work.

A spring sown barley nursery of twenty-two varieties and strains was seriously damaged by drought but finally produced fairly good yields. The highest yield was produced by Harlan Hybrid 1-31-45, which averaged 47.4 bushels per acre, and Harlan Hybrid 1-33-437, which averaged 43.7 bushels per acre. Standard varieties, Coast and Stravopol, produced 43.2 and 43.1 bushels per acre, while Finley and Bailey because of their late maturity produced the lowest yields of 23.1 and 22.4 bushels per acre. Over the six year period Stavropol and Vaughn are the leading varieties, averaging 34.8 and 33.7 bushels respectively.

Flax: Six varieties of flax were grown this season, as they have been since 1931. The season was unfavorable for flax, the lowest yields ever produced at this station, being recorded. Leading varieties over a period of years are North Dakota 114 and Bison. The average yield of all varieties for the optimum date of planting is 12.8 bushels per acre.

Perilla and Chia: A small planting of Perilla and Chia, plants whose seeds are used for drying oils, was made this season. The weather conditions were unfavorable throughout the summer for setting of seed, although plant growth was fair. Chia plants died of some disease, thought to be cotton root rot but not identified.

I. M. Atkins, Bu. Pl. Ind., U. S. D. A.

Corn Variety Experiments

Eighteen varieties of corn were planted in four replications on March 22, 1937. All varieties were damaged somewhat by dry weather the latter part of May and again the latter half of July. The more drought resistant varieties made the highest yields and those of medium or late maturity were more severely damaged by the dry weather in July. Ferguson Surcropper, Surcropper 3008, and Mexican June made the highest yields of 32.8, 31.4, and 31.0 bushels per acre respectively. Yellow Surcropper '35, Skiles Yellow Dent, Yellow Surcropper '36, Denco Yellow Dent, Yellow Surcropper '37, Golden June, and Red June all yielded approximately the same, and not significantly less than the three leading varieties. Ferguson Yellow Dent, Synthetic Yellow Dent No. 35, Blankenmyer White Dent, Teague Yellow Dent, and Stairs Yellow Surcropper made the lowest yields of 26.5, 26.0, 25.3, 24.6, and 24.1 bushels per acre respectively. The average yields of eight varieties grown during the period 1933-37 are as follows: Ferguson Surcropper, 25.3; Surcropper 3008, 24.9; Reese's Drought Resister, 24.5; Red June, 23.6; Ferguson Yellow Dent, Denco Yellow Dent and Synthetic Yellow Dent No. 1, each with yields of 22.6; and Blankenmyer White, 21 9. This low average for the five years is largely due to the exceptionally low yields made in 1934.

Corn Breeding

Fifty-four first year hybrids of inbred strains of yellow dent x Yellow Surcropper together with ten hybrid strains from Iowa and four common varieties were planted four times each in a test to determine the relative value of the inbred Yellow Dent strains represented in the crosses as indicated by plant vigor, resistance to smut and worm damage, ear type and productiveness. Vigor of plant growth was noticeably greater in a large number of the hybrids than in the parents and other varieties. However, final yields did not reflect this hybrid vigor, except in a few instances. There were noticeable differences in resistance to smut and worm damage, and in general the data collected this year, and in previous years, will give a fair index to the inherited factors for general adaptability and productiveness of the inbred lines involved in the crosses.

Corn Versus Grain Sorghums

Four varieties of grain sorghum, Darso, Hegari, Chiltex, and Ajax, are grown in direct comparison with Surcropper corn. The yields this year were exceptionally good, averaging 65.5 bushels for Chiltex, 47.7 for Hegari, 46.7 for Ajax, and 46.6 for Darso, as compared with 34.6 for Surcropper corn.

During the period of years 1928-1937 inclusive, Chiltex averaged 32.4 bushels, Darso 30.6, Hegari 25.0, and Ajax 24.8, as compared with 25.1 bushels for Surcropper corn. During this same period of years the average yield of dry forage in tons per acre was 3.24 for Hegari, 3.17 for Darso, 2.54 for Ajax, and 2.47 for Chiltex.

Since the average yield of grain is slightly greater for the best grain sorghums than for corn, and the forage produced is considerably more valuable than that of corn, it is believed that the grain sorghums could profitably be grown in place of corn on the drier and less fertile uplands of this area.

Effect of Grain Sorghum and Corn Upon the Succeeding Crops

In this study of the effect of grain sorghum and corn on the following crops, the average yields indicate that those crops, such as fall wheat and barley and spring oats, which are planted soon after the sorghum stubble is turned under are damaged more than later planted crops, such as corn, cotton, cowpeas, etc. The five year average yield of wheat following sorghums is 20 bushels and following corn 25 bushels; barley following sorghums 29 bushels and following corn 35 bushels; oats following sorghums 53 bushels and following corn 57; corn following sorghums and corn following corn made equal yields of 17 bushels; cotton following sorghums 215 lbs., and following corn 225 lbs.; early planted cowpeas following sorghums .50 and following corn .53 tons dry forage per acre; medium date planting of cowpeas .64 following sorghums, and .66 following corn; late planted cowpeas .62 following sorghums, and .62 following corn. The yields of the different crops following Darso, Hegari, Chiltex, and Ajax indicate that there is a difference between the different sorghum varieties in their effect upon following crops, but this difference is so slight that it should not be considered in the selection of a grain sorghum variety. In farm practice sorghum stubble should be plowed under as soon as possible in the fall in order to obtain as much decay as possible before planting the next crop. Sorghum stubble plowed under while still green and when there is good soil moisture tends to increase rather than decrease the yield of the following crops, particularly those crops which are planted the following April or later.

Effects of Interplanting Corn and Grain Sorghums

In inaugurating this test it was assumed that corn planted early and sorghum planted late could be interplanted in such a way that the competition for moisture and plant food would not occur at the critical stage of development of either of the crops and that the yields of both corn and sorghum might thereby be increased. Two sorghum varieties, Darso and Backhul kafir, were planted in alternate two-row plats with Surcropper corn. During the four years 1933-1937 kafir planted alone yielded 16.4 bushels, and 15.2 when alternated with corn; Darso planted alone yielded 25.3, and 26.1 when alternated with corn; corn planted alone yielded 21.5 and 29.1 when alternated with kafir; corn alternated with Darso yielded 26.9 bushels per acre. Both kafir and Darso yielded approximately the same amount of dry forage per acre when planted alone as when planted in alternate two-row plats with Surcropper corn. The increased yield of grain obtained by planting grain sorghums and corn in alternate two-row plats is probably not sufficient to make this method of planting practical for the farmer in this area.

Cotton Variety Test

A summary of six replications of randomized plats of eighteen varieties and strains of cotton planted this season shows that Sunshine Selections 74-2 and 83-3, Watson, Bryant Mebane, Harper, Qualla, Lankart, Rogers

Acala and Mebane 141 made the highest yields of 314, 307, 302, 295, 295, 294, 293, 291, and 291 pounds of lint per acre respectively. With the exception of the two Sunshine selections the difference in yield between the other varieties is not significant. Half and Half with a yield of 241 lbs. lint was the lowest in the test this year.

Comparable average yields of the commercially important varieties grown during the ten year period 1928-1937 show Half and Half, Watson, Cliett, Ferguson 406, and New Boykin leading all other varieties with yields of 304, 300, 289, 287, and 285 pounds lint per acre respectively. Acala with a yield of 270 pounds ranks above many of the Mebane, Rowden, and Lone Star strains.

Cotton Breeding: Twenty-eight inbred lines of Sunshine cotton T. S. No. 10104 were planted again this year in four replications of randomized plats. The purpose of this test is to determine the effect of inbreeding on the general uniformity of plant growth, boll type, maturity, staple length, and other characters in comparison with those of the common Sunshine parent. Thus far in this work several very excellent strains have been obtained. Strain Nos. 74-2 and 83-3 are being increased for distribution to farmers.

Fertilizers

Results obtained from the use of commercial fertilizers and barnyard manure applied to wheat, corn and cotton during the nine year period 1928-1936 have been published, and 1937 tests were confined to the use of phosphate and ammonium sulphate in varying rates and combinations on winter wheat. Results obtained previous to this year indicate that the use of commercial fertilizers was not profitable for cotton and corn and that further testing of nitrogen and phosphate should be continued only on wheat.

In the test with wheat this year 100 and 200 lbs. each of phosphate and ammonium sulphate increased the yield of wheat approximately two bushels above that of wheat receiving only phosphate at the rate of 100 and 200 lbs. Applying 200 lbs. of phosphate and 100 lbs. of ammonium sulphate at planting time in the fall, and then adding 100 lbs. of ammonium sulphate about the middle of March did not increase the yield of wheat above that receiving equal amounts of phosphate and ammonium sulphate applied only in the fall. The no-treatment plats yielded 26.9 bushels as compared with 32.7 bushels for the phosphate and ammonium sulphate plats, and 30.5 bushels for the phosphate plats.

On the basis of tests at this station commercial fertilizers cannot be recommended for use on the black uplands of this region. Barnyard manure and green manure crops, such as legumes, small grains, cane, etc., ordinarily increase crop yields much more than commercial fertilizers.

Legumes

Fall Planted: Tests of a large number of winter legumes conducted since 1932 indicate that Austrian winter peas, hairy vetch, Black Medic, bur clover, and alfalfa are about equal in the production of forage, and perhaps the only legumes that the farmer could plant in the fall with fair assurance of escaping freeze damage, and having sufficient growth to turn under in March or early April to prove profitable. Such winter legumes as Crimson clover, Red clover, Hop clover, Subterranean clover, Alsike clover, and Dutch clover rarely produce enough top growth to be worth while as green manure, or as pasture crops.

Spring Planted: Sweet clover is the outstanding legume for general purpose use on the black uplands of this region. The biennial white variety is the best and most commonly used for hay, pasture, or soil building. The annual white (Hubam) makes more rapid growth and is usually ready to harvest as hay or to be turned under as green manure about June 15. For this reason this variety probably should be used in preference to any other summer legume on land infected with cotton root rot. None of the sweet clovers is sufficiently winter hardy to be fall planted in north and northwest Texas.

The black uplands of north Texas are too high in lime and the summers are usually too dry for satisfactory growth of lespedeza and crotalaria. Lespedeza sericea makes fairly good growth, but the forage is unpalatable to livestock, and it should be used only as a green manure crop.

For late spring and early summer planting cowpeas generally are more satisfactory than other varieties and types of legumes, such as soybeans, mung beans, sesbania, etc. The best varieties for forage and soil building are Brabham, Groit, and Whipporwill. Soy beans have yielded slightly more forage than cowpeas in station tests, but rarely have produced seed worth harvesting.

Soy Bean Variety and Date of Planting Test

A variety test of soy beans has been conducted at this station since 1923, and since 1931 Mammoth Yellow, Laredo, and Otootan have been grown regularly. Fifteen varieties have been included in this test for the two years 1936-1937. The average yields of Mammoth Yellow, Laredo, and Otootan since 1931 are .92, .99 and .99 tons dry forage per acre respectively. The leading varieties for the past two years at the early date of planting (about March 20) are Easy Cook, Laredo, Delnoshat, Mamredo, and Tokio with yields of 1.36, .95, .90, .85 and .85 tons dry forage per acre respectively. Mamredo, Laredo, Easy Cook, Palmetto, and Creloe, with yields of 1.02, 1.00, .93, .92 and .90 are the leading varieties at the medium date of planting (about April 20). Laredo, Delnoshat, Otootan, Tokio, and Ovoyelles, with yields of .92, .90, .85, .84 and .84 are the leading varieties at the late date of planting (about May 20). Manchu, a short, early maturing variety, is the only one of the fifteen varieties grown that developed and matured seed in both of the last two years, and the average yield was only 5 bushels.

All varieties, except Mammoth Brown and Mamloxi, made seed in 1936; the lowest yields being less than 1 bushel for Mamredo, and the highest yield approximately 15 bushels for Easy Cook. The three varieties grown since 1931 failed to produce seed worth harvesting in any year of the test.

Varieties of soy beans that consistently will produce profitable yields of seed in this area may be discovered or developed, but, in the meantime, only those varieties that produce good yields and quality of forage can be recommended. The Laredo variety is the most highly recommended because of its consistent production of good quality forage and the fact that it is less palatable to rabbits.

Inoculation of soy beans has been found unnecessary.

The rate of planting for small-seeded varieties, like Laredo or Otootan, should be about 25 lbs.; varieties of medium size seed about 35 lbs., and large-seeded varieties about 50 lbs. per acre.

Sweet Clover

Since sweet clover has been the outstanding legume at this station for soil improvement, pasture, and hay production, a considerable amount of work has been done in testing different methods of planting and handling the crop. It has been found that sweet clover planted alone in drilled plats, 18 inch row plats and 36 inch row plats yielded approximately the same in the first year of growth, but the second year growth in 18 inch and 36 inch rows was slightly more than in the drilled plats. In extremely dry years, the 18 inch and 36 inch row plantings are considerably more productive of both pasture and hay than the drilled plantings.

Sweet clover planted in 18 inch and 36 inch rows and drilled in spring oats as a nurse crop seldom makes sufficient growth after the harvest of oats to be cut for hay or to be worth much as a green manure crop. However, the second year growth of this clover is approximately the same as that planted alone. The yield of oats is reduced slightly when sweet clover is intertilled as described above. However, planting sweet clover in oats is often good farm practice because of the greater residue obtained from oats than from first year sweet clover. Planting sweet clover in three-foot rows in oats is preferable to thicker planting because of greater ability to withstand extreme dry weather and the fact that the rows can be cultivated.

A test to determine the practicability of planting sweet clover and sudan grass in alternate rows has been conducted for the past four years. Results indicate that planting these two crops in alternate 18 inch or 36 inch rows is probably not practical. The sudan severely retards the growth of first year clover, and second year clover severely retards the growth of sudan. It is probable that alternate two or three row plantings of these two crops would compete with each other less severely and be practical under average farm conditions. When the two crops are planted in this manner grazing of the first year growth of clover should not start until about June 15, or when the clover is four to five inches high.

The best variety of sweet clover is the biennial white, which is the variety commonly handled by all seed companies. A very excellent strain of biennial yellow bloom sweet clover is being increased at this station for distribution to farmers. In numerous tests this strain has produced more and better quality forage than any other strain or variety. Hubam, the annual white blooming variety, has not produced as much forage or grazing as the biennial variety, but its use is recommended on soil infected with cotton root rot because it matures sufficiently early to escape infection.

Sweet clover cannot be fall planted in north Texas with any assurance of withstanding winter freezes. When sweet clover is planted alone, February to March 15 is recommended planting time, but when planted in spring, oats plantings should be made immediately after the oats are drilled.

Crop Rotation Studies

A special crop rotation study involving eleven different types of rotations was started in the fall of 1930 for the purpose of determining just what type of crop rotation might be the most practical and economical on the black lands of north Texas. Since an experiment of this kind must run over a long period of years before definite conclusions can be reached, results thus far are only indicative of what might be expected.

Cotton grown continuously on the same land and receiving 4-12-4 commercial fertilizer at the rate of 400 lbs. per acre and cotton grown continuously on the same land without any fertilizer treatment made the lowest yields of 198 and 224 lbs. of lint per acre respectively. The low yields of these treatments, as compared with cotton in the various rotations, apparently are not due to inadequate plant food nutrients. The yields of cotton in the various rotations ranged from 232 to 263 lbs. of lint per acre. The difference between the different types of rotation cannot be fully accounted for by the presence or absence of a legume crop, or a green manure crop plowed under. It is obvious that cotton yields better when rotated with some other crop, but what position it takes in either a two-year, three-year or four-year rotation is of little consequence. The amount of cotton root rot infection is slightly greater in the rotations which include sweet clover or cowpeas.

Corn in ten types of two-year, three-year and four-year rotations has not yielded significantly higher than corn grown continuously on the same land. The slight advantage in yield for the rotations which include winter peas, sweet clover, or cowpeas is likely due to the greater amount of organic matter and the higher water holding capacity of the soil.

Wheat grown continuously on the same land has an average yield of 26.5 bushels compared with 28.0 bushels for wheat in a four-year rotation with corn, oats and sweet clover.

Oats in four types of three-year and four-year rotations yielded from 64.2 to 68.7 bushels as compared with 59.3 bushels for oats grown continuously on the same land.

Pasture Experiments

Results of an experiment to determine the relative amount of pasture provided by small grains and rye grass through the winter and early spring, and to determine the effect on yields when grazing was stopped February 15, March 1 and March 15, have been published in Bulletin No. 539.

Dallis grass has been found unsatisfactory when planted as a supplement to native grass pasture. This grass will not withstand constant grazing or severe, dry summer weather.

Rescue grass in pure stands, or planted in the early fall as a supplement to native grass pasture has proved very satisfactory for winter and early spring grazing. This grass occurs naturally on all native grass land of this area because it readily reseeds itself under close grazing. Forage harvested by hand from cultivated test plats during the past three years has averaged .87 tons per acre.

Italian rye grass planted in the early fall on native grass pasture has also proved very satisfactory. This grass does not readily reseed itself and for best results must be planted each year at the rate of about 15 lbs. per acre. In cultivated test plats this grass has averaged .91 tons dry forage during the past three years. This is equal to the forage obtained from any of the small grains grown under comparable conditions.

Satisfactory stands of other grasses, such as Western Wheat Grass, Blue Gramma, and the Blue Stems have not been obtained and data on their relative value for this area cannot yet be given.

Buffalo is the predominant grass in all native grass pastures on the black uplands of this area. Experiments in seeding and sodding this grass are under way.

Inheritance of the Polled Character in Rambouillet Sheep

This project was started in 1930 for the purpose of assisting in the determination of the factor, or factors, involved in the inheritance of the polled character in Rambouillet sheep so that strains may be purified to the extent that horned males cease to appear. Since this project is carried under the direction of the Division of Range Animal Husbandry, the results of this study are included in the report of that Division.

P. B. Dunkle.

SUBSTATION NO. 7, SPUR

Substation No. 7, Spur, is located one mile west of Spur, Dickens county, latitude 33 degrees north, longitude 100 degrees west, at an elevation of

2274 feet above sea level. Spur is located on the Rolling Plains of Texas, being 14 miles east of the escarpment known as the Cap Rock, which forms the line of division between the High Plains and the Rolling Plains of West Texas. The average annual rainfall for 27 years is 21.09 inches with extremes of 11.09 inches and 38.08 inches. The average length of growing season is 214 days. The station comprises 413.92 acres, of which 380 acres are in cultivation and the remainder in native grass pastures. The soils consist of Abilene and Miles clay loams and are characteristic of a large portion of the soils of Northwest Texas.

The station is concerned with three principal lines of research: the development of profitable crop farming under conditions existing in the region; the utilization of feed crops grown in the section in the fattening of cattle and sheep; complete conservation and utilization of rainfall, including storm water from rough areas, in the production of cultivated and native plants.

The crop season of 1937 began with better than normal soil moisture, but seasonal rainfall distribution was such as to cause early-planted crops to suffer before late summer rains began. Late planted crops were fruiting at the time these rains began and made yields higher than average.

Cotton Experiments

Varieties of Cotton: The highest yielding cotton variety in 1937 was Bryant's Mebane with 276 pounds of 31/32-inch lint per acre. This variety was followed closely in yield by Half and Half, Watson (a Mebane strain), Mebane (A. D.), and Mebane 141. All the Mebane strains ginned out 40 per cent or more of lint to seed cotton, and the lint was from 7/8 to 31/32 inch in length. The gin turnout of Half and Half was 47.0 per cent lint that was 3 4 inch in length but a grade higher than any of the Mebane strains. Over a long period of years the Mebane strains and Half and Half have been the more dependable yielders. The soil type on which these variety tests were conducted is Abilene clay loam, which is generally considered to be a drouthy soil. Under these conditions the Mebane strains are possibly the more profitable ones to grow on account of the longer fiber produced. Larger yields and also greater length of fiber are usually obtained on the sandy soils of the region. Many of the cotton varieties which produce untenderable staple on the station soils during dry years produce tenderable staple on the nearby sandier soils.

Date of Planting Cotton: In this test, which has been in progress since 1916, plantings are made at ten-day intervals from April 10 to July 10. There has been considerable variation in optimum planting date from year to year due to varying soil moisture conditions and unusually long or short growing seasons. In 1937 the highest yield, 433 pounds of lint per acre, was obtained from the planting made on June 10. The June 1 planting produced 413 pounds of lint per acre. The next highest yield, 226 pounds of lint, was obtained from the May 20 planting. It is a rare occurrence for plantings made as late as June 1 and 10 to out-yield so far all the other plantings. This is accounted for this season, however, by the fact that the later plantings had sufficient soil moisture reserve to carry them through the extremely drouthy season during June, July, and August and did not begin fruiting heavily until after the rains in late August. Earlier-planted cotton exhausted its supply of soil moisture with plant growth and heavy fruiting during the drouthy season, and severe shedding of squares, blooms, and bolls occurred. These plants did not recover rapidly enough after the August rains to set a crop of bolls that could mature before frost. Over a period of years plantings made at the middle of May have given the highest average yield and the crop has been produced more economically.

Spacing of Cotton: In this test the spacing between plants in 36-inch rows is increased by 3-inch intervals from 3 inches to 36 inches. Poor stands this year precluded the testing of the closer spacings. Over a period of 18 years the differences in yield from spacings of 9 to 27 inches have been small. Apparently the plants adjust themselves satisfactorily to any spacing within this range. Moisture supply is the factor determining the optimum distance of spacing. In years of scant rainfall the higher yields are obtained from wide spacings, while the reverse is true in years when soil moisture is plentiful.

Cultivation of Cotton: Different plats of cotton are cultivated at intervals of two weeks, giving the several plats from one to seven cultivations. During a period of fifteen years the highest average yield of lint cotton per acre has been obtained from two cultivations. In 1937 the highest yield was obtained by giving three cultivations. An unusually heavy growth of weeds occurred from planting time through early summer, and it was necessary to give at least three cultivations in order to kill all weeds. As a general rule cultivation is needed only when the crop is weedy or grassy. An insufficient number of cultivations to kill weeds causes undue competition for moisture between the crop and weeds and results in lowered yields. Cultivations above the number required to kill weeds generally come at a time after the crop has extended an elaborate root system across the rows. If even shallow cultivating is done at this stage of the plant's development, some of the larger roots are severed. The result is a reduction in yield.

Grain Sorghum Experiments

Grain Sorghum Varieties: In 1937 eighteen varieties of grain sorghum were given grain yield trials. Rainfall distribution was such that two crops of heads were produced by most of the varieties, which were planted on May 15. The yield from the first harvest was very low for all varieties, but a comparatively high yield of sucker or second growth heads was made following heavy rains in August. Hegari made the highest total yield for the year, 84.6 bushels of grain per acre as compared with the following yields of some of the more commonly grown varieties: Texas blackhul kafir, 57.6 bushels; Dwarf yellow milo, 30.4 bushels; Spur feterita, 27.3 bushels. The performance of Hegari this year is quite characteristic.

When conditions are almost ideal for grain production it gives yields that are unusually high, but when conditions are only slightly adverse, it generally does not produce grain. During the past ten years Hegari has failed to produce grain or has made negligible yields in four years, while milo, kafir, and feterita have made enough grain in all of these years to warrant being harvested and have, therefore, been the more dependable yielders over a period of years.

Date of Planting Milo: The highest yield of grain, 48.4 bushels per acre, was made in 1937 by the planting made on June 10. The next highest yield was 42.7 bushels from the June 1 planting, while the planting made on May 20 yielded only 7.7 bushels. Early plantings this year were fruiting during the drouth period of July and August, and there was not sufficient reserve of soil moisture to mature a normal crop of grain. The later plantings began fruiting in the latter part of August and were benefited by the late August rains. Over a period of years plantings made in the last half of May and the first half of June have given the highest yields of grain. These yields, however, have not been consistent from year to year and have varied more with preseasonal and seasonal moisture conditions than with dates of planting. If soil moisture conditions are favorable for planting and for plant growth, May plantings are desirable. With less favorable moisture conditions, a portion of the crop should be planted later. A superior quality of forage for bundle feed or for silage has been obtained from plantings made in June and July.

Method of Planting Milo: The practice of plowing out or leaving unplanted every other row or every third row of milo is being widely used in some sections of West Texas. The data from the milo method of planting test indicate that this practice, as ordinarily put into operation, merely gives a more nearly optimum stand than would usually be obtained were all the rows planted. The chief advantage of this method of planting, therefore, is that it is a cheap method of thinning. Its main disadvantage is that the unplanted rows are too frequently left uncultivated, thus promoting a growth of weeds that gives greater competition to the crop for soil moisture than would be the case if the blank rows were planted. The average yield of grain per acre for three methods of planting are as follows: 36-inch rows, 28.5 bushels; 72-inch rows, 26.4 bushels; 36-inch rows with every third row unplanted, 29.1 bushels. A practical plan is to plant every row and then, depending upon soil moisture conditions and the stand secured, to leave all plants or to plow out every other row or every third row after the plants are six to eight inches high.

Cultivation of Milo: In this test the crop is intertilled at intervals of two weeks during the growing season, giving different plats a total of no cultivation to seven cultivations. In 1937, and also as an average of fourteen years, the highest yield has been made by giving three cultivations. In general, the results indicate that cultivations above the number required to kill weeds result in decreased yields.

R. E. Dickson, B. C. Langley.

Soil and Water Conservation Studies

(In cooperation with Soil Conservation Service, U. S. Department of Agriculture)

The experiments at this station relate particularly to the Southern great plains area. This project has been under way for twelve years and has for its purpose the study of the factors influencing run-off losses and soil erosion and the effect of water and soil conservation practices on crop production. The factors contributing to run-off and soil losses are studied on control plats 1/75 acre in area. The efficiency of different terracing systems and other obstructions and of different crops in preventing water and soil losses is studied on field areas varying in size from 6 to 120 acres.

Control Plats: The rainfall for 1937 was 20.28 inches, which is .81 inch below the 27-year mean. During the twelve-year period that this test has been in progress the annual rainfall has been below the long-time mean eight years and above four years. The average for the twelve years, however, is only .35 inch below the average for 27 years. The rainfall during this period is therefore fairly characteristic of the amount and distribution that may be expected in this region. The extremes of yearly rainfall for the twelve-year period are 38.08 inches in 1926 and 12.88 inches in 1934. The season of 1937 was characterized by a prolonged drought period through the last 25 days of June, all of July and the first 15 days of August, during which time little if any effective rain fell. This drought period was followed by a rainy period in late August and early September. During this rainy period the rainfall amounted to 7.49 inches, or 37 per cent of the yearly total, and caused 88 per cent of the run-off from control plats. Forty-three per cent of the rain causing run-off was torrential, or fell at the rate of .75 inch or more per hour.

Rains of a torrential character are to be anticipated in this region, and, in order that rainfall of this nature may be conserved for use in crop production, it is highly important to resort to some measure of run-off control.

Over a period of years the relation of vegetative cover and the physical condition of the land in checking water and soil losses is indicated by the following treatments given in order of their effectiveness in reducing these losses: buffalo grass, milo, cotton, cultivated fallow, uncultivated fallow. Both water and soil losses were directly related to the amount of vegetative cover on the land. The largest losses occurred from land that had no vegative cover, either dead or living. Cultivation has decreased the water loss by 36 per cent on fallow land.

The effect of slope on run-off from plats planted to cotton is shown by the following average annual losses: level, 1.33 inches; 1 per cent slope, 3.13 inches; 2 per cent slope, 3.22 inches.

Field Areas: To make use of the soil as a storage place for water is an idea that is rapidly gaining favor in the region and is being put into practice extensively.

Observations made over a long period of years at this station show that seasonal rainfall is usually insufficient to produce normal crops. Although seasonal rainfall is of great importance, it is definitely known that the amount of soil moisture present at planting time is an almost unfailing indication of good, fair or poor yields to follow. Preseasonal rainfall, or that part of the preseasonal rainfall that is stored in the soil, plays, therefore, a role in farming and ranching that cannot profitably be overlooked. The pedocals, or lime bearing soils of the region, as a general rule are sufficiently deep and porous to absorb within the root zone of cultivated and range plants much more water than normally occurs as rainfall and to absorb this water rapidly enough to prevent waterlogging of the soil and drowning out of crops. On practically all of these soils, however, even those of a sandy nature, it is necessary that some obstruction be provided to retard the movement of water during heavy down-pours so that the water will have sufficient time to penetrate into the soil. Soil type, slope of land and crops grown will determine the nature of the obstructions to be used.

Modifications must necessarily be made when flood water, in addition to that which falls on the land, is being diverted on to this land. The following data from field areas of 6 to 10 acres in size give the successive steps taken in water control and the effectiveness of certain measures in reducing the loss of water from crop land and in increasing crop yields during the 11-year period, 1927-1937.

Average Yields and Run-off from Field Areas

Treatment	Inches water lost	Inches water added	Yield, lbs. lint cotton per acre
Terraces sloping 3 in. per 100 ft.	2.26	0	102
Contoured rows, no terraces	.84	0	130
Level terraces, ends open	.77	0	133
Level terraces, ends closed	0	0	150
Level terraces, ends closed, outside water added	....	2.82	175

Syrup Pan Terrace System: Since April, 1931, the run-off from a 1200-acre watershed has been diverted on to a 120-acre tract of cultivated land that has a system of level terraces with alternate ends open for conducting the water back and forth across the field as it flows toward the lower end. In 1937 two rain periods totaling 6.06 inches produced sufficient run-off on the watershed to cause 5.48 inches of water to flow into the syrup pan system. The rainfall plus the additional flood water is equivalent to a rain of 11.54 inches. All of this water was stored in the soil and was used in maturing a bumper feed and cotton crop, with some being left as a reserve for the following year's crops. Less than one-half of the rains that have caused water to flow into the system have produced a large enough flow to cover all of the 120 acres. Water from the other flows has been held and stored in the soil on the upper 56 acres. The amount of water available for use in crop production has been increased above the normal rainfall 23.3 per cent on the upper 56 acres and 14.9 per cent on the remainder of the field. The damage to growing crops from the addition of this water has been negligible. The foregoing results show the effectiveness of level terraces not only in checking and holding water that falls on the land but also in distributing quantities of waste water that may be diverted on to the land. Opportunities in the region are unlimited for the diversion and use of waste water on cultivated and range land from roadways, small streams, and watersheds.

The chief aim, therefore, of water conservation research at this station is to develop a flexible system of water management and utilization that will reduce farming and ranching risks and tend to stabilize production through periods of deficient rainfall. This applies not only to such years as 1934 when rainfall was below normal every month, but also to the mid-summer depression in rainfall that occurs over the region in almost every year.

Pasture Improvement Studies: The application of water management practices to native grass pastures has in recent years received serious consideration throughout the West. Continued drouths have reduced the grass cover in some areas to the point where the land can not profitably be used for grazing. Various practices have been evolved in an effort to revive vegetation on almost denuded pasture land, each practice being based upon some peculiarity of soil type or climate.

Pasture improvement studies were begun at this station in 1932, at which time an observational block of native grassland was solid contour listed at intervals of 39 inches. Additional blocks were given similar treatment in 1934, 1936, and 1937. Other treatments have included terracing, strip listing and diversion of water on to pasture land from roadways. The land used in these experiments has a slope of 1 to 3 per cent and the soil type is Miles clay loam.

The vegetation on the pasture land before listing was predominantly buffalo grass (Buchloe dactyloides) with a mixture of other grasses and weeds. The yield of vegetation from the unlisted blocks and from those solid listed to a depth of 3 inches at 39-inch intervals are given below:

Yields from Listed and Unlisted Areas

Treatment	Yield, Lbs. Air-dry Vegetation Per Acre			
	1935	1936	1937	Average
Unlisted	858	592	259	570
Contour listed 1934	2424	2315	1133	1957
Contour listed 1936	....	1326	2159	1742

The rainfall this year was especially unfavorable for summer grass production. A large carry-over of soil moisture from the fall of 1936 encouraged a heavy growth of winter weeds and grasses which consumed the moisture supply before summer grasses began growing, and a deficiency of rainfall through the spring and summer prevented normal growth from taking place.

It has been the belief at this Station that solid contour listing under conditions that prevail here has been the most profitable and practical procedure for rejuvenating native grass pastures and increasing the carrying capacity. This belief was based largely on the observation that stimulated grass growth had not occurred except within the listed area, and that yields within the listed area were more than three times as large as fields from unlisted areas. Extension of practices and studies, however, now suggest that there may be other methods, under certain soil and topography, where an unequal distribution of water over grass land may result in even higher carrying capacity than that from an equal distribution. Possibly the best use for much of the rough and stony land in the drier sections is to produce run-off water for areas where large amounts may be profitably used in the production of grass.

The ratio of the cover of weeds to grass on the unlisted land has increased appreciably during the drouth years of 1934-35-36. There also has been a marked change in the basal cover of the different species of plants on the listed land, but this ratio is the reverse of that above. Measurements on quadruplicate meter quadrats made in June, 1937 show the effect of listing on the relative and total density of the several species of vegetation, as shown in the table below.

Per Cent Basal Cover on Listed and Unlisted Areas in 1937

Vegetation	Per Cent Basal Cover		
	Unlisted	Listed 1934	Listed 1936
Buffalo grass	9.33	61.04	60.23
Blue grama	.99	2.96	1.51
Purple three awn	1.65	2.66	1.99
Other grasses	1.45	1.71	2.57
Other plants	7.41	3.85	4.02
Undesirable plants	8.05*	1.29	2.52
Total basal cover	28.88	73.51	72.84
Bare ground	71.12	26.49	27.16

*6.29 per cent of this was bitterweed.

The most striking evidence of the beneficial effect of listing is the comparison of the per cent cover of buffalo grass on the three areas. While the unlisted land has a cover of buffalo grass of only 9.33 per cent, the blocks listed in 1934 and 1936 both have a cover of this grass of over 60 per cent. The undesirable plants on the unlisted land are chiefly bitterweed, a poisonous plant that is very destructive to sheep.

Livestock pastured on these experimental areas have been carried at the average rate of 1 animal unit on 5.1 acres. This compares very favorably with the carrying capacity of local range land of 18 to 20 acres per animal unit.

Buffalo Grass Selections: On May 15, 1934, a group of selections of 44 staminate and 44 pistillate plants of buffalo grass were set in plats 5 feet square. By mid-summer of 1935 the plants had spread sufficiently to cover completely the 25 square feet allotted to each. Yield and other data have been obtained, and a great amount of variation has been found to exist in vegetative characteristics, seed production, and seasonal growth. In 1937 the highest yield from one of these selections was at the rate of 6939 pounds of air dry grass per acre and the lowest was 1452 pounds. The average yield for the staminate plants was 4334 pounds and for the pistillate, 4084 pounds. Seed production ranged from 429 pounds per acre for the lowest to 3613 pounds for the highest, and the weight of 100 seed varied from .28 gram to 1.04 gram.

The diversity of types or strains to be found among this group of plants makes it evident that there are unlimited opportunities for the improvement of buffalo grass by selection. The more promising selections are being planted in increase blocks.

R. E. Dickson, B. C. Langley, C. E. Fisher.

Cattle Feeding Experiments

(In cooperation with the Bureau of Animal Industry, U. S. Department of Agriculture)

Fifty head of yearling steers purchased from SMS Ranch in May, 1936, were grazed on native grass pasture and sudan grass until November 1. At that time they were placed in dry lot and fed silage and cottonseed meal until started on test December 9. These cattle were in medium flesh and had gained an average of 217 pounds per head in the 194 days of grazing and preliminary feeding.

The steers were divided into five lots and fed various amounts of cottonseed meal and cottonseed oil with sumac silage to determine the relative value of different amounts of cottonseed meal and fat in silage and meal rations. Rations fed the several lots were as follows:

Lot 1. Cottonseed meal, 4.0 pounds; cottonseed oil, .18 pound.
Lot 2. Cottonseed meal, 5.5 pounds; cottonseed oil, .09 pound.
Lot 3. Cottonseed meal, 7.0 pounds.
Lot 4. Cottonseed meal, 4.0 pounds; cottonseed oil, .58 pound.
Lot 5. Cottonseed meal, 4.0 pounds; cottonseed oil, .98 pound.

All lots received the same amounts of roughage, and because of a shortage of silage moderate amounts of chopped dry roughage were fed to extend the feeding period. Although a short feeding period of 122 days failed to produce the most desirable market finish, the cattle sold well, dressed 61.3%, and yielded carcasses which graded medium.

Comparison of Different Amounts of Cottonseed Meal: In general the results obtained from feeding 4.0, 5.5, and 7.0 pounds of cottonseed meal to supplement the silage were directly related to the amount of meal fed. Lot 1, receiving 4.0 pounds of meal, was underfed as compared to the other lots and made the least gain. As would be expected, these cattle also yielded the lightest carcasses with the lowest average carcass grade, yet had the highest carcass cost per cwt. to the packer. Carcass grades favored the lots in order 3, 2, and 1, Lots 3 and 2 having noticeably higher finish than Lot 1. Cost of gain favored the lots in order 1, 2, and 3 on basis of feedlot weights and in order 2, 1, and 3 on basis of market weights. Net returns favored Lot 1 but would have favored Lot 2 had it not been for lower selling prices caused by a "staggy" steer. Considering gain, carcass weight, dressing per cent, carcass grade and feed cost per hundred pounds gain, Lot 2, fed the mid-amount of cottonseed meal, fell just about midway between Lots 1 and 3, but in the light of marketability of steers and profit these cattle made the best showing.

The Effect of Fat (fed as cottonseed oil) in Cottonseed Meal and Silage Rations: Lack of finish as a result of the short feeding period made comparisons of the various amounts of fat less significant than in the previous test in which similar cattle reached high finish in 175 days.

Two lots (1 and 4), fed .18 and .58 pound of cottonseed oil respectively, made the same gains and reached similar finish on practically the same total feed, yet Lot 4 out-sold Lot 1 by 15 cents per hundred, dressed 1.71% higher and consequently yielded heavier carcasses. The average carcass grade, however, was higher for Lot 1. Lot 5, fed .96 pound of cottonseed oil, made slightly higher gains than the other two lots, therefore yielding heavier carcasses with a higher average grade even though the dressing per cent lay between the other two lots. This was done with 19 pounds less cottonseed meal and 165 pounds less silage than was consumed by either of the other two lots.

Although the high cost of cottonseed oil ($200 per ton) caused the lots receiving the higher levels to show unfavorable financial returns it does have value as a fattening feed in small amounts.

Two lots of cattle fed 5.5 and 7.0 pounds of cottonseed meal attained higher finish and yielded carcasses of higher grade than three lots fed 4.0 pounds of cottonseed meal and .18, .58 and .96 pound of cottonseed oil in addition.

Carotene Requirements for Fattening Steers: The previously inaugurated project to determine the carotene requirements for growing and fattening steers was continued during the past year with a narrower range of levels fed.

Fifty head of good-to-choice 470 pound Hereford steer calves were divided into two groups. One group of 40 head was depleted of vitamin A storage on a ration of 3% tankage, 10% cottonseed meal and 87% cottonseed hulls. The other group of 10 head was fed the same ration but in addition received 800 micrograms of carotene per hundred pounds live weight daily (supplied in alfalfa meal) from the beginning of the experiment. As the 40 head became depleted they were placed on fattening rations furnishing from 450 to 1000 micrograms of carotene per hundred pounds live weight daily.

Night blindness appeared to be the most reliable index to the onset of depletion and first occurred at 101 days. Two steers resisted the effect of the deficient ration for 206 days, while the average was 135.8 days with 65% of the cattle falling between 125 and 160 days. Other symptoms of deficiency noted were excessive discharge from eyes and nose, slobbering, swelling of the joints, suffering from high temperatures, loss in weight, wobbly gait, and convulsions.

Results obtained with calves during the past year were as follows:

(1) 450 micrograms of carotene per hundred pounds live weight daily was not sufficient to control night blindness, all steers carried on the level becoming completely night blind, and one developed day blindness. Numerous cases of convulsions occurred on this level, and two steers carried for an extended period died after 140 days.

(2) Cases of convulsions and sickness occurred on levels of 600 and 750 micrograms, and complete night blindness occurred in the majority of cases.

(3) 800 micrograms of carotene per hundred pounds live weight daily fed to calves from time of weaning failed to prevent the occurrence of night blindness in a single case, but a considerably longer period of time was required than for cattle on depletion ration. Several cases of total night blindness and one case of convulsions were noted. When raised to 2000 units of vitamin A in cod liver oil or 2000 micrograms of carotene in alfalfa meal per hundred pounds live weight daily, these cattle quickly regained normal night vision.

(4) Cattle fed 1000 micrograms of carotene (supplied in alfalfa meal) per hundred pounds live weight daily for an average period of 120 days did not improve in night vision but slowly approached complete night blindness.

(5) Cattle raised from 750 to 1250 micrograms of carotene showed slight improvement in night vision at the end of 21 days.

(6) There did not appear to be any great difference in gains on the various carotene levels fed.

Studies on blood chemistry and histology of eyes, optic nerves, and brains of these steers are being carried on by the Division of Veterinary Science and results are to be found under the report of that Division.

R. E. Dickson, J. H. Jones, John K. Riggs.

SUBSTATION NO. 8, LUBBOCK

Substation No. 8 is located three miles east of Lubbock, Lubbock County; latitude 38 degrees and 37 minutes north, longitude 101 degrees and 45 minutes west; elevation 3215 feet above sea level. The average annual rainfall over a period of 27 years was 19.05 inches, with yearly extremes of 8.73 and 31.88 inches. The rainfall for 1937 amounted to 22.25 inches. The Station comprises 160 acres of land, 152 in cultivation and the remainder in pasture. The soil is of the Amarillo and Richfield fine sandy loam type, which is typical of a great portion of the region.

The Station is the only one located on the High Plains region of Texas in a new agricultural section of the State. The principal objectives are as follows: the introduction, breeding, and improvement of the grain and forage sorghums which have been found to be the basic agricultural crops of the region; the breeding and improvement of varieties of cotton adapted to high altitude, limited moisture, mechanical harvesting; the determination of the best method of soil management and crop treatment in the region; the collection of reliable information on fruit and truck crops, shade and ornamental trees and shrubs, legumes, and other plants essential to a well-rounded-out agricultural program.

Grain Sorghum Experiments

Grain Sorghum Varieties: The principal varieties of grain sorghums grown in this region are milo, kafir, and hegari. Bulletin No. 459, "Grain Sorghum Varieties in Texas," covers the work at this Station for the period 1912-1931. Beginning in 1932, a large number of new varieties, largely of hybrid parentage, have been grown in comparison with milo, kafir, and hegari. The new varieties are made up of sorghums created to fill certain needs for harvesting, earliness, and bundle-feeding. On account of the deficiency in rainfall during the period 1933-1935, the early varieties have made the best yields, resulting in larger acreages of Early Yellow Milo. In addition to Early Yellow Milo, Wonder, Club, and Early Kalo have made comparatively high yields for the period 1932-1937.

Hegari in Paired Rows: Hegari planted in normal spaced rows with 12-inch plant spacing has averaged 18.4 bushels to the acre for the past seven years as compared to 18.6 for paired rows. Under the same conditions the forage yields have been 2.21 and 2.20 tons.

Where 8-inch spacing was used in the paired rows, producing the same number of plants as in the normal spaced rows, yields over a 6-year period were 18.9 bushels to the acre in normal spacing and 17.1 in paired rows. Forage averaged 2.22 and 2.32 tons per acre.

Grain Sorghum Improvement: A breeding project with sorghums has been carried on for a period of years with the specific objectives of producing attractive colored sorghum varieties or strains that will be dependable during recurring years of subnormal rainfall, produce economies in harvesting, and be resistant to diseases. Early Yellow Milo, which has large seed and rather small erect heads was distributed in 1933 and seems to have a definite place in this area, as it is a consistent producer. New selections of milo resistant to "Milo Blight," *(Pythium arrhenomanes)* were again tested in 1937, and some 20,000 pounds of seed of the best disease resistant strains will be distributed from this station during the spring of 1938. Several early maturing strains of a milo-hegari cross with red seed and erect heads in the F_7 are ready for limited distribution as well as several kafir-milo and Red kafir-hegari crosses. This last produces an extremely heavy crop of grain and forage under good rainfall conditions and probably will have a place in Central Texas. Approximately 800 progeny rows of various crosses and back crosses were planted this year.

Cotton Experiments

Cotton Varieties: Thirty-six varieties of cotton were grown in 1937, ranging in staple length from 13/16 for Half and Half to 1 3/32 for Rogers Acala. Excessive rains and cool weather the first of the season necessitated replanting and caused a great deal of angular leaf spot. Flea hoppers caused a great amount of shedding up to August 10. As a whole, the crop was put on after August 10. Clear, dry weather prevailed during the fall, producing ideal harvesting conditions. The average yield of lint cotton for all varieties was 392 pounds. The five highest yielding strains with yields were: Lentz Acala 556; Mebane 539; Rogers Acala 522; Half and Half 501; Paymaster 498. The two lowest were H-X 277 and Texas Special 295.

Treatment of Cottonseed:. In a comparison of fuzzy and delinted seed, fuzzy planted at the rate of twenty pounds per acre and delinted at ten pounds. The delinted seed germinated at a more rapid rate for the first two days after emergence started, but by the end of the third day, the fuzzy seed had a larger per cent above the ground. There was no difference in the percentage of seed to germinate by the end of the period.

Delinted seed treated with Ceresan at the rate of two ounces per bushel did not germinate at a faster rate than the untreated delinted seed, and the final germination showed no significant difference.

Cotton Breeding: The cotton improvement program at this Station has centered around pure-lining various strains and varieties with outstanding characteristics desirable in a cotton for this area. So far, selection work has shown none of these new strains to be outstanding enough to supplant those already being grown. A number of crosses and back crosses made in an effort to combine some of the desirable qualities are now in the F_2 and F_3 generations and have shown considerable promise from the standpoint of earliness, length of fiber, adaptibility to machine harvesting, and storm resistance. Further selections to increase lint turn-out are being made. One of the new selections in a comparative test of harvesting methods produced a middling grade of cotton for all three methods of harvesting—picking, snapping, and mechanical harvesting.

Cotton Row Spacing: In normal row spacing, a plant spacing of 12 and 8 inches was used. Where paired rows were used, the plant spacing was

8 and 4 inches which produced the same number of plants as were used in the normal row plats. Normal rows produced 387 and 375 pounds of lint cotton per acre for the two spacings used, while paired rows averaged 287 and 307 respectively. This indicates that the practice of using paired rows results in a decided loss in yield under conditions such as existed in 1937.

Small Grain Pastures: Barley, oats, rye, and wheat are sown in small plats the latter part of September for a winter pasture test. Usually barley and oats are either winter-killed or stunted to such an extent that yields are reduced. Barley, on account of its exceedingly fast growth in the fall and early winter, affords considerable early pasturage. This year, seven clippings were made from seedings made September 29. Fifty-two days after seeding the first clipping was made, with barley making its heaviest growth during this period. The balance of the clippings were made at intervals of 33, 62, 31, 14, 16, and 11 days in the order named. Rye, with 22,570 pounds of green forage per acre, produced the greatest tonnage, followed by wheat, barley, oats, and rye grass, with yields of 17,900, 11,470, 6,350, and 3,970 in the order named.

Buffalo Grass (Buchloe Dactyloides) Pasture: During early September, 1936, an acre of the cultivated pasture was plowed, leveled, and borders thrown up for the purpose of seeding to Buffalo Grass. Within a week or two after leveling, 13.93 inches of rain fell. This settled the ground and provided excellent moisture. By May, 1937, the top soil was dry for several inches, but good subsoil moisture still existed. On May 14 the entire area was set out to Buffalo Grass, with three-inch cubes set in rows three feet apart each way. Three acre-inches of water was then applied, packing the soil about the roots to start growth. On account of the excellent rains throughout the summer, no additional irrigation was required. Measurements were made on twenty-five consecutive cubes on July 12, August 16, and December 29, to obtain information as to the rate of growth made by the stolons. The average length for the three periods was as follows: 15.56, 27.28, and 33.32 inches. Rainfall was above normal for the season, amounting to 4.00, 3.12, 1.32, 2.06, and 3.85 inches for the months May to September inclusive.

Horticultural Experiments: Yields of grapes were considerably under the average this year, the limiting factor being the shedding of fruit during the time it was setting. The cause of the abortion is unknown, but may have been due to lack of fertilization, strong dry winds, or a combination of these two factors. Bird damage was again severe. Armalaga, Brilliant, Catawba, Edna, Longfellow, and Nitodal were the highest producing varieties this year, with yields ranging from 4 to 8 pounds per vine.

Date and Method of Preparing Seedbed: The seedbed is prepared during January and April. Two methods and depths are used, namely, plowing and listing and 3.5 and 7 inches deep.

Results with Grain Sorghums: This year, there was no significant difference in either the date or method used, although the April prepared ground returned slightly higher yields than the January preparation, and the plowing method was a little better than the listing. Seven-inch prepared seedbed returned the highest yields, regardless of the method used.

Results with Cotton: January prepared ground averaged 249 pounds of lint per acre as compared to 316 for April preparation. Plowing averaged 288 and listing 276 pounds. Seven-inch prepared seedbed averaged 298 and three and one half depth, 265 pounds. Where the seedbed was prepared in January, there was little difference between deep listing or plowing, but deep preparation was better than shallow.

Soil Fertility and Moisture Conservation: Forty-two 1/10 acre plats are devoted to a study to determine the effect of continuous cropping, fallow, crop rotation, and manuring with barnyard and green manure, on crop production and soil moisture. Cotton and grain sorghums crops are grown, with Sorgo being used for green manure.

Results with Cotton: This year the average for the twenty-one plats was 515 pounds of lint per acre. The highest yield, 591 pounds, was obtained from a 3-year rotation of cotton after grain sorghums manured after fallow. The lowest yield was made from a four year rotation, cotton after fallow after green manure after grain sorghum. Cotton continuously cropped for twenty-three years averaged 506 pounds. Where cotton had been cropped continuously for twenty-three years and barnyard manure applied at the rate of two tons per acre, the yield was 526 pounds.

Results with Grain Sorghums: Twenty-one plats were cropped to grain sorghums. The three highest plats were as follows:

Grain sorghum after fallow after green manure after cotton....	43 bu.
Grain sorghum after cotton after fallow..........................	42.8 bu.
Grain sorghum alternated with fallow..........................	42 bu.

Where grain sorghums have been grown continuously for twenty-three years, the average was 37.3 bushels, as compared to 36 bushels where barnyard manure at the rate of one ton per acre was applied.

Commercial Fertilizer: An application of 100 pounds of ammonium sulphate is applied to both cotton and grain sorghums. This year there was a difference between the unfertilized and fertilized plots amounting to 24 pounds of lint cotton per acre. Where grain sorghums were cropped, unfertilized plots averaged 25.8 bushels as compared to 36.4 where fertilizer was used.

Barnyard Manure and Cotton Burs: Plats receiving no fertilizer are compared with those receiving two, four, and eight tons of barnyard manure and two tons of cotton burs per acre. Excellent subsoil conditions existed throughout the winter, spring, and summer. Acre yields of lint cotton of 344, 458, 451, 524, and 427 pounds were obtained from no fertilizer, two, four, and eight tons of barnyard fertilizer, and two tons of cotton burs in the order named.

Cotton and Grain Sorghum under Pump Irrigation: An experiment to determine the total amount of irrigation water necessary to produce maximum yields and the best time of application was started in 1936. As set up, the experiment calls for the following treatments: No irrigation, a pre-planting irrigation sometime in February and another in April, one pre-planting and one in early summer, one pre-planting and two in summer some three to four weeks apart. All irrigations are applied at the rate of three acre-inches. The post-planting irrigations are applied, as nearly as possible, at the most effective time.

Results with Cotton: Plats receiving no water outside of rainfall averaged 469 pounds per acre as compared to 510 for the one pre-planting watering; 559 pounds, where two pre-planting irrigations were made; 569 pounds, with one each of pre-planting and post-planting; 521 pounds, with one pre-planting and two post-planting.

Results with Grain Sorghums: Hegari was the grain sorghum variety used, and received the same treatment as above. The yields in order were 33.1, 32.1, 34.2, 56.9, and 60.2 bushels per acre.

D. L. Jones, Frank Gaines.

Forest Nursery: A small nursery is maintained at the station. In connection with the arboretum, emphasis is laid on material suitable for windbreak, shelterbelt, and woodlot planting. Trees suitable for windbreak, woodlot, and shelterbelt plantings are distributed to the farmers at a nominal cost.

Approximately 125,000 trees were distributed this year.

D. L. Jones, Frank Gaines.

Storing Pork in West Texas: In this test, conducted in cooperation with the Division of Swine Husbandry, and Texas Extension Service, hams and bacons receiving the same treatment as to cure and smoke were stored in January, 1937, in crude cottonseed oil, commercially refined, and home refined cottonseed oil, soybean oil, peanut oil, and mineral oil. This meat was compared with hams and bacons stored in the yellow wash and air-slaked lime methods. Two hams and two bacons were used in each method. At the end of three months, a ham was taken out of crude and one out of refined cottonseed oil and divided among six people. All pronounced both of good flavor and no difference between the two oils. At the end of six months, the remaining hams and bacon were again divided. This time, the same people were about evenly divided that the bacon stored in crude cottonseed oil had a decided cottonseed flavor, with two finding it objectionable. Two stated the ham had a slight flavor; the others stated it was not noticeable. All meat stored in oil showed practically no shrinkage, while that stored in lime and yellow-wash had heavy molds and a shrinkage amounting to from 12 to 20 per cent. Results indicate that crude cottonseed oil can be used for a limited time, and refined oil for one to two years. Both air-slaked lime and yellow wash methods of preserving meat showed a large shrinkage and heavy mold.

Fred Hale, Roy Snyder, D. L. Jones.

SUBSTATION NO. 9, BALMORHEA

Substation No. 9 comprises 200 acres of land located in the Madera Valley at the foot of the Davis Mountains. It is adjacent to the O. S. T. highway and is approximately four miles east of Balmorhea. This section and the surrounding territory is served by the Pecos Valley Southern Railroad, which is a branch of the T. & P. Railway.

The elevation at the Station is approximately 3200 feet, but this changes rapidly from southwest to northeast, the fall being about 40 feet per mile. The latitude is 31 degrees north and the longitude 103 degrees west. There is a great variation in the annual rainfall from year to year, but it is never sufficient to justify the production of staple crops without the aid of irrigation water. The average annual precipitation for the past fifteen years has been 13.81 inches with a maximum of 28.15 inches in 1932 and a minimum of 3.89 inches in 1934. The annual evaporation for the past twelve years has been above 60 inches. The rate of evaporation is highest during May, June, July, and August. Average evaporation for these four growing months is more than 30 inches and the high rate makes necessary the use of a large amount of irrigation water in crop production. This water is obtained principally from flowing springs but this is supplemented by flood water from the Davis Mountains, which is stored in an earthen reservoir.

The work of Substation No. 9 deals principally with the problems of crop production under irrigation, the proper use of these crops as cash crops and for the purpose of fattening livestock, and with the development of information and knowledge which will make possible more attractive living conditions in the irrigated sections of western Texas. Work with livestock has consisted principally of developing a system of feeding cattle whereby a large proportion of roughage and a minimum amount of grain may be used to finish cattle for market.

Cattle Feeding Investigations

The primary object of the feeding work here has centered around the utilization of the large amounts of roughages commonly grown in this area in fattening and finishing cattle. The work, therefore, has served in the utilization of these home-grown feeds by marketing them through livestock. It has been found that rations including minimum amounts of concentrates and maximum amounts of roughage yield satisfactory and economical gains and a high finish of animals fed. These results indicate that ground hegari fodder produces better gains than alfalfa hay when fed alone to form the roughage portion of the ration, but a combination of ground hegari and alfalfa produces better results than either fed alone. The addition of calcium carbonate supplements has not been worth while. A comparison of self-fed steers and hand feeding resulted in almost equal gains in both lots, with a slightly greater feed consumption for the self-fed lot.

Crop Experiments

The agronomic work at this station has dealt largely with the staple crops adapted to the region. These are cotton, sorghums, alfalfa, and miscellaneous crops of less importance.

Cotton: Extensive tests of cotton varieties over a period of 15 years have proved that the best adapted strains of Acala cotton are superior to other varieties for general planting in the irrigated sections of West Texas. The leading strains of Acala have been the Rogers, Young's, and the New Mexico Agricultural College strains. These have made about equal yields and there has not been much difference in quality. Length of lint has been 1 1/32 to 1 1/16. Half and Half has made more lint per acre, but staple length has averaged only 25/32 inches. Many varieties such as Mebane, Kasch, Lankart, and others have a tendency to be late in maturing when grown under irrigation and are not as well adapted as the best strains of Acala. Under special conditions of fertile soil and heavy rainfall where ordinary varieties are likely to overgrow, the Stoneville cottons have given the best yields, but Acala is recommended for general planting.

Applications of various fertilizers to cotton have indicated that these soils are not deficient in sulphur, potash, or lime. Nitrogenous fertilizers have given increased yields of cotton, especially when applied as a side dressing after the crop has begun to fruit. Superphosphate has given some increase in yields of cotton but shown a greater increase when applied to alfalfa.

Sorghums: Sorghum variety tests have shown that for general feeding purposes hegari is one of the best, since it produces a high yield of grain and a fair yield of forage of excellent quality. As a strictly forage sorghum, the sumac is one of the best. Dwarf Yellow Milo is the best grain variety. Since bird damage is usually heavy on small fields, the station has adopted the practice of planting about 10 percent of some tall growing sorghum such as sumac along with the hegari. This gives the hegari much protection when cut and shocked in the fields.

Legume Crops: Alfalfa is the outstanding legume for the southwest, and trials over a period of years which included most of the legumes grown in the U. S. have shown that few of them are adapted to the climatic conditions of this section. Hubam clover, Biennial Sweet Clover, and Melilotus Indica grow well but are less valuable than alfalfa. Lespedeza Crotalaria, beggar weed, guar, and most varieties of beans are not well adapted. Soybeans and cowpeas make a fair growth but are not well enough adapted to justify their use on an extensive scale. Sesbania makes a thrifty growth and always produces an abundance of nodules but has no value except for soil improvement purposes.

Fruit Adaptability Trials: Because of the unfavorable climatic and soil conditions the planting of orchards and vineyards should be largely for local and home use. Trials with large numbers of varieties of the principal tree fruits have shown that the greatest handicaps to commercial fruit growing are late spring frosts, low humidity, high temperatures, and the presence of cotton root rot in many soils. Peaches, plums, pears, apricots, pecans, and jujubes are among the best of the tree fruits for soils not infected with the root rot fungus. Apples are better adapted to the higher altitudes. Every farm should have a few fruit trees even though crops cannot be expected every year.

Vineyard Management: During the years from 1924 to 1930 a large number of varieties of both vinifera and American species of grapes were planted on the Substation. A few hardy varieties have survived over this period but many of the less hardy have died from various causes. In general the vinifera types are better adapted to climatic conditions and the best of these have been Rose of Peru and Thompson Seedless. Others that have made a fair showing have been Tokay, Mission, Muscat, Cornichon, and Black Hamburg. Champanel, Last Rose, and Black Spanish have been among the few American varieties which have been able to survive climatic conditions. The Champanel has been most resistant to the root rot and, when used as a root stock for vinifera varieties, has made these varieties immune to the disease. It appears to be valuable for this purpose.

Ornamental Adaptability Trials: Because of the climatic conditions of West Texas, the high summer temperatures, low humidity, and light rainfall, only a limited number of varieties of trees and other ornamentals are well adapted here. Work on the Station has included trials with a large number of different varieties of both broadleaved and coniferous trees and shrubs in an attempt to determine those most suitable for use as ornamentals in this section. As a class the arbovitae, junipers, cypresses, and most hardy broadleaved trees and shrubs are best suited. The various varieties of arborvitae, Red Cedar, Italian Cypress, Arizona cypress, Pfitzer's juniper, flowering willow, live oak, flowering pomegranate, vitex, honeysuckle, and others have shown some resistance to the cotton root rot and have proved to be hardy. Many varieties of privet, Euonymous, hardy roses, mulberry, species of cottonwoods, locust, Chinese elm, Russian olive, and many others will withstand the climatic conditions but are quite susceptible to the cotton root rot disease.

J. J. Bayles.

SUBSTATION NO. 10, FEEDING AND BREEDING STATION

Substation No. 10 is located at College Station, Brazos county, one mile northwest of the College on the public highway; its latitude is 30 degrees north and its longitude 96 degrees west; it is 308 feet above sea-level. The annual average rainfall over a period of 40 years was 38.02 inches. The land owend and assigned to the Feeding and Breeding Station comprises 920.8 acres.

The work of this station embraces investigations in the feeding, breeding, and management of swine, dairy cattle, poultry, goats, and sheep. Progress of work on projects with these animals is treated elsewhere in this report under the respective divisions concerned.

Of the land embraced in this station, approximately 150 acres are in cultivated crops, 200 acres in improved pasture, and the remaining 570.8 acres in native pasture.

SUBSTATION NO. 11, NACOGDOCHES

Substation No. 11 comprising 81.6 acres of land, is located one-half mile north of the city limits of Nacogdoches, Nacogdoches County, on State Highway No. 35; its latitude is 32 degrees north and its longitude 94 degrees west; its elevation is 292 feet above sea level. The average annual rainfall over a period of 25 years was 49.01 inches. During this period an average of 15.65 inches, or 31.93 per cent of the total average annual rainfall occurred during the months of May, June, July, and August, but this year 8.16 inches has fallen during these months. The average length of growing season during a 24-year period is 248 days, with the average last killing frost in the spring occurring March 13, and the average first killing frost in the fall occurring November 15. The purpose of this station is to serve the region of Texas in which the Nacogdoches soils, or "Redlands," occur. The redlands of the Nacogdoches soil series were among the earliest-settled farm lands in the State. This soil in the virgin state is productive, but since much of it has been in cultivation for a long time, one of the chief problems of the Station is that of finding the most effective and the most practicable systems of cropping for building up and maintaining soil fertility. Other studies concern the use of fertilizers, including rate and time of application, and the development of horticultural and agronomic crops suited to a diversified agricultural program for this region.

Soil Improvement Investigations

Preliminary Studies of Artificial Plats for Field Experiments: In accordance with the proposed revision of all soil fertility studies at this station, the use of artificial concrete tank plats was continued in order further to test their reliability for use in field experiments. Three series of tanks, consisting of twenty 1/1000 acre plats each, are available for this work.

Because of continued loss of plants from Fusarium wilt, former studies on cotton and tomatoes were abandoned in favor of a grass rooted crop which was not susceptible to this disease, Sudan grass being selected. Nine fertilizer treatments and one soil check were used in connection with the planting of the Sudan grass, each treatment being replicated six times. A summary of the yields of dry forage obtained during 1937 from these treatments shows an increase from their use in every instance over that of the unfertilized area, with the exception of the treatment where 400 pounds per acre of an 0-8-4 fertilizer was applied. A definite and consistent increase was obtained where the amount of a 4-8-4 fertllizer was increased from 200 to 400 to 600 pounds per acre. Nitrogen is apparently the main plant food required, as varying amounts from none to eight per cent produced consistent increases of dry forage. Varying results were had from the different rates of phosphoric acid applied. Potash treatments showed little influence on the amount of plant growth.

Fertilizer and Seed Treatment Studies

The cooperative project with the Division of Agricultural Engineering, the Bureau of Agricultural Engineering of the U. S. Department of Agriculture, and their agencies, wherein the placement of commercial fertilizers in respect to its position with the cotton seed was being studied, was terminated at the close of the 1935 season. The results of this test are set forth in Texas Station Bulletin No. 548, "Machine Placement of Fertilizer for Cotton." During the 1936 season new studies were begun on the effect of disturbing the seed bed when applying fertilizer at different positions in relation to the cotton seed. A further cooperative study on the use of fungicides on cotton seed prior to planting was also inaugurated during the season. The work was continued during 1937 and the results of both studies are reported fully in the Division of Agricultural Engineering.

Crop Experiments

Cotton Varieties: Texas Station Bulletin No. 384, "Varieties of Cotton for Central East Texas," provides a conclusive summary of cotton varietal characters and yields as determined by their study during the period 1921 to 1927 inclusive. A compilation by Mr. D. T. Killough, Agronomist, on variety tests of cotton in Texas and published as Progress Report No. 472, covers the period of years 1926 to 1935 inclusive, at this station. In this report the total value of lint and seed per acre shows the following varieties to be the more profitable for this section: Ferguson 406, Lankart, Sunshine, Acala (Rogers), Russell, Half and Half, Lone Star, Kasch, and New Boykin, in order named.

Results secured from the 1937 test on five varieties shows Half and Half, Watsons, New Boykin, Lone Star, and Acala, in order named, to have the highest yield of lint per acre. Acala produced the longest staple of 1-1/32, and Half and Half the shortest of 13/16 inch. Watson had the largest boll of all varieties studied, while Half and Half had the smallest.

Cotton Breeding: In a continuation of the cotton breeding work of this Station, sixty-three progeny rows of plant selections from the 1936 F_6 progeny rows, and their parents, were grown. These selections were from strains of a cross of Half and Half X Lone Star made by D. T. Killough, Cotton Breeder, Division of Agronomy. Within these sixty-three progeny rows, three plants of desirable type were selected per row for inbreeding purposes, eight to twelve selfed bolls per plant being secured. Each individual plant was harvested separately for further laboratory selection of these inbred plants for planting during the 1938 season. A planting for increase during 1938 was made during the season of sixty-one progeny rows from individual open-pollinated selected plants from best progeny rows grown during 1936. Ten individual plants were selected and harvested for further laboratory analysis as to length, per cent, and yield of staple. One lock sample was taken from each individual plant in all of the progeny rows for laboratory analysis in order to have a comparative standard for making the field selections.

During 1935 a number of the F_5 inbred selections from the Half and Half X Lone Star cross were back-crossed on the Half and Half parent and from this material eighteen selections of the F_1 back-cross were grown during 1936. Eleven of these selections were further used for back-crossing on Half and Half during the 1936 season, with ample seed being secured from both the back-crosses and selfs made. Additional initial crosses and selfs were made during the season on selfed plants of the Lone Star and Half and Half varieties. Twenty selections were made from the 1936 back-crosses and further back-crossed during 1937 on the female parent Half and Half. Two selections of initial crosses made during 1936 were back-crossed on selfed plants of each of its parents, Half and Half, and Lone Star, during the 1937 season. An increase planting was made of 12 B/C selections which proved to be outstanding during the 1936 season.

A randomized field yield strain test begun during 1935 was continued this season with thirty-three selected selfed strains of the Half and Half X Lone Star cross, 3 B/C strains, and selfed selections of the parent varieties, along with commercial seed of the two parent varieties. Results this season show the selfed parental variety to have produced greater yields of lint than the planting from commercial seed, length of staple being the same. Two selections of B/C strains and one selfed selection outyielded the highest producing selfed parent.

Corn Inheritance and Improvement: The work at this station pertaining to the improvement of corn for this section continues the work with the inbred strains of Surcropper and Nacogdoches varieties selected at this station, with the addition of selected inbred strains from other stations. It also included the development of a yellow prolific corn for East Texas.

During 1937 a field yield strain test of thirty-six inbred strains which were top-crossed with Texas Golden Prolific during 1936, and four commercial varieties, was planted in four replications. A study of the average yields of shelled corn per acre from this test shows that twenty-eight of the strains exceeded the yields of Hastings Prolific, twenty-five out-yielded Mexican June, twenty-one were more productive than Yellow Surcropper, and fourteen surpassed Ferguson Yellow Dent. Of the ten highest producing strains, Nacogdoches had five representative strains, Mosshart three, and Blue Grain two.

In connection with the development of a yellow prolific corn for East Texas, 63 selfed ears were selected from 500 selfs made during 1936, for planting in triplicate replications for an increase cross-pollination block, and field yield strain test, during the 1937 season. Increase from the planting showed twenty-six selfed ears having progeny which were desirable for increasing as Registered seed during the 1938 season.

In order to advance the date of maturity of the Texas Golden Prolific variety it was crossed with Yellow Surcropper during 1937. An adequate supply of seed from the cross was secured for making the necessary back-crosses during 1938.

The first distribution of the Texas Golden Prolific corn was made following the 1937 crop. The total supply of 28.5 bushels of registered seed was distributed to twenty-three persons and organizations. Shipment of the seed corn was made to four states, California, Oklahoma, Georgia, and Texas.

Winter and Summer Forage Crops: During the year twenty-two varieties of summer growing legumes, consisting of five cowpea varieties, five soybeans, three velvet beans, five lespedezas, two crotalarias, and one each of Guar, and Beggarweed, were planted in quadruplicate. Two replications were inoculated with an artificial culture, while two replications were not treated. Because of unfavorable soil moisture conditions poor stands were secured and the test was abandoned for the season. A summary of six years work shows that the greatest production of dry forage per acre might be expected from Crotalaria spectabilis, Osceola velvet bean, Brabham cowpea, Early Speckle velvet bean, and O-Too-Tan soybean, in order named. During this period Korean lespedeza has produced the highest yields of the five varieties of lespedeza grown. Lespedeza sericea is disappointing because of poor stands secured under East Texas conditions and the spindly type of plant growth both under cultivated and permanent pasture conditions. For permanent pastures, Kobe, Japan, and Tennessee 76 are to be recommended on account of their ability to continue growth under grazing conditions during the dry summer months.

During the fall of 1936 a planting was made in quadruplicate of three varieties of vetch, two alfalfa, twelve clovers, two winter peas, also one each of Dallis, Rescue, and Italian Rye grass. One-half of the replications were inoculated with an artificial culture. Yields of dry forage obtained from the planting showed the ten highest producers to be subterranean clover 3.6 tons, hairy vetch 3.0 tons, purple vetch 2.5 tons, Oregon vetch 2.3 tons, Canada field pea 1.9 tons, red clover 1. 8 tons, crimson clover 1.8 tons, Austrian winter pea 1.6 tons, hop clover 1.3 tons, and White Dutch clover 1.2 tons. Italian Rye grass with a production of 4.8 tons dry forage per acre was the highest yielder of all winter cover crops planted.

A review of the results secured during the period 1932-1937, inclusive, shows Hairy and Oregon to be the more productive of the vetches; subterranean, red, and White Dutch produced the highest yields of all clovers; Hairy Peruvian was the outstanding alfalfa variety; Tangier peas outyielded Austrian winter pea, and Canada field pea; while Italian rye grass, and Rescue grass, were the more productive of the winter grasses planted. Of all varieties planted, Italian rye grass, hairy vetch, subterranean clover, Oregon vetch, rescue grass, and red clover, produced the highest yields of dry forage, in order named.

Legume Inoculation: In cooperation with the Nitragin Company, Milwaukee, Wisconsin, studies were continued this season for the purpose of determining the value of applying artificial inoculum culture prior to planting the seed of summer and winter growing legumes. As reported under "Summer Legumes," no yields were obtained this season because of unfavorable soil moisture conditions at time of planting.

A review of two-years studies on the effect of inoculating seed of summer growing legumes shows a definite increase of yields of dry forage per acre from the use of the inoculum on six varieties of cowpeas. With the exception of one variety, there was a favorable increase in yield of forage from the inoculation treatment on four varieties of soybeans. Valvet beans inoculated with the Nitragin culture did not produce yields as large as the check treatment. The varieties of lespedezas varied in their response to the artificial inoculation of seed prior to planting, three of the varieties failing to produce yields comparable to those of the untreated plats. Neither of the Crotalarias tested gave any response to artificial inoculation, while Guar showed a 37 per cent increase over the non-inoculated planting.

Results obtained from inoculation studies on nineteen varieties of winter growing legumes planted during the winter of 1936-37 show each variety of vetch responding to the treatment. Neither the Austrian winter pea nor the Canada field pea responded to the inoculation treatment according to yields of dry forage obtained. Two varieties of alfalfa showed decided response to the inoculation. Only two out of twelve clovers failed to show a favorable increase of forage from the inoculated areas over the uninoculated ones.

Horticultural Crop Investigations

Blackberry and Dewberry Variety Studies: For a number of years a report has been made of the adaptation, plant and fruit characters, and desirability of a large number of blackberry and dewberry varieties as grown at this station. Texas Station Bulletin No. 558, "Blackberry and Dewberry Varieties in East Texas," contains a complete report of all varieties studied. The present study includes only those varieties proving to be well adapted to our conditions and serving as a standard of comparison for any new material studied.

Blackberry and Dewberry Breeding: Rubus breeding at this station is being conducted along two lines, to produce high yielding varieties and strains that are superior in flavor and quality to the existing adapted varieties. At the same time an effort is being made to establish certain desirable vegetative characteristics, as breeding material.

First, a large number of crosses have been made, with the Young dewberry, Crandall's Early, and Hall's Lawton blackberries as pollen parents. These varieties were crossed with a number of other varieties having desired characters and also crossed with each other.

Second, a large number of selected varieties have been inbred in order to isolate the factors desired for further crossing.

In continuation of the work 850 self-pollinations were made on eleven varieties of blackberries and dewberries this season. Several hundred crosses were made between eight varieties, with Young dewberry being used as a pollen parent in a greater proportion of the crosses. Certain F_1 seedlings grown from 1935 crosses and selfs proved of sufficient promise that twenty of the seedlings were backcrossed to each of their parents during 1937. An ample supply of seed from each backcross was secured for growing the B/C populations. A large number of selfs were also made on each of the selected F_1 seedlings. Approximately 500 F_1 seedlings from the 1936 crosses and selfs were planted in permanent locations this season.

Blackberry Cultural Studies: The cultural studies of the blackberry, as formerly reported under fertilizer, thinning, and pruning studies, were discontinued following the 1936 season because of the rapid increase of plants producing partially-developed fruits. The planting was utilized in making further studies in an effort to determine the cause of the partial-sterility. A report of the work to date is made in Technical Series No. 437, "The Effect of Partial Sterility on Fruit and Cane Development of Blackberry and Dewberry Varieties," written for the 1937 Proceedings of the American Society for Horticultural Science.

Tomato Disease Studies: Continued studies were made at College Station, Jacksonville, and Nacogdoches, during the year on a number of plant and fruit diseases affecting the tomato in East Texas. The report of the work at College Station will be shown under the report of the Division of Plant Pathology and Physiology. The report of the Tomato Disease Laboratory at Jacksonville is included in the report of this station.

An Attempt to Control Soil-Borne Tomato Pathogens

A test was made to determine the effect of 10 per cent sulphuric acid on the soil organisms *Fusarium* sp, *Sclerotium rolfsii,* and nematodes pathogenic to tomato plants. A plat known to be heavily infested with these organisms was treated with 10 per cent sulphuric acid by volume, by punching holes at 6-inch intervals to a depth of two feet and filling the holes with the acid. This treatment was followed by plowing shallow furrows two feet apart across the plat, after which the plat was flooded with the diluted acid. A total of 265 gallons of acid were applied to the holes and an additional 265 gallons used in flooding the area. The pH values of the soil were determined and the lime necessary to bring the pH to neutrality was applied. Tomato plants were set out in the plat but because of the prolonged drought conditions and extremely high temperatures the plants in the treated plat as well as the adjacent untreated plats did not survive. Those plants in the untreated plat succumbed two weeks later than those of the treated plat. Continued unfavorable weather conditions prevented the growth of tomato seed planted in the latter part of July. Tomato plants will be planted on these plats during the 1938 season and the results should indicate the value of the acid treatment as a means of eliminating soil-borne plant pathogens.

Adaptability Investigations with Fruit Crops

During 1933 Project No. 216, "Adaptability Investigations with Fruit Crops," was revised with the Texas Extension Service cooperating. At this station a site was selected and terraces constructed. The trees were spaced twenty feet apart on the terrace, and the terraces were spaced twenty feet apart. The planting to date includes three trees each of seventy-seven standard varieties of peaches, ten lots of selected peach seedlings from College Station, seven lots of selected seedling plums from the same source, six standard varieties of plums, and six standard varieties of pears. During the fall of 1936 a thermograph was set up in the orchard in order to secure a record of the number of hours the fruit buds were exposed to temperatures of 45 degrees or less, in line with the study to determine the amount of cold required for normal flowering. During the period of October 27, 1936, to March 1, 1937, a total of 1086 hours had temperatures of 45 degrees or less.

Ornamental Adaptation Study

The purpose of this propect is to have at this station specimens of both local and foreign plants in order to accumulate ecological data for the local nurserymen and landscape gardeners. A large portion of the material is used in developing the landscape design of the station farmstead. Such material included in the test this year does not have sufficient promise as to merit its being described in detail.

Tung Oil and Slash Pine

Continued work was done during the year on plantings of Tung Oil, and Slash pine in the use of submarginal lands of East Texas by reforesting in connection with the development of permanent pastures.

Because of a minimum temperature of 29 degrees which occurred March 31, at the time the Tung Oil buds were unfolding the entire crop of Tung nuts was lost this season. A planting was made in the station nursery of nuts secured from the 1936 crop and selected from trees that are late bloomers and productive. This planting has provided 250 Tung seedlings, which are available for further selection work on cold resistance.

A cooperative fertilizer test on Tung oil trees was begun during 1936 with the Fuller's Earth Plant, Nacogdoches, Texas. Tree measurements obtained this season showed an average increase in height of 114 cms. (45 inches) for the year when four pounds of 4-8-4 fertilizer was applied to each tree. Those trees not receiving a fertilizer treatment made 53 cms. (21 inches) new growth during the year.

A cooperative adaptation test on Slash pine to the Nacogdoches soils is being conducted with the Texas Forest Service. Growth records obtained showed an average new growth of 38.6 inches made during 1937. A number of the trees are 14 feet in height with the tallest one 15.5 feet.

H. F. Morris.

EAST TEXAS PASTURE INVESTIGATIONS, LUFKIN

The East Texas Pasture Investigations Laboratory is located six miles west of Lufkin, in Angelina County, Texas. The property is located on the south side of State Highway No. 94, is adjacent to the Hudson Consolidated School, and contains 217.57 acres of owned land and 11.1 acres of leased land. All of the land except approximately three acres is utilized for grazing, and of this approximately one third is open pasture. The remainder is covered with new growth pine and hardwood timber. The latitude is 31 degrees and 23 minutes north and the longitude is 94 degrees and 54 minutes west. The average rainfall at the Station since its establishment in 1933 is 41.75 inches. The total rainfall this year was 53.13 inches. The soil is predominantly Lufkin fine sand and sandy loam, which is characteristic of considerable land in the East Texas Forest Region.

The principal problems with which this Station deals are beef cattle improvement and pasture improvement. Means for improving sugar cane grown for sirup are also being studied. The Station represents the entire East Texas Forest Region in these studies. According to the Texas Forest Service in its circular No. 8, there are approximately 1,414,000 acres of cut-over pine and hardwood land in East Texas that now has a poor reproduction of timber. Very little utilization is being made of this land for any other purpose. If this land is not reproducing timber, then it should lend itself more readily to livestock production than almost any other agricultural enterprise. However, at present, when this cut-over land is being utilized for stock-raising, low-quality stock are the rule with high-quality stock the exception. In general, the range is composed of coarse, low-quality forage. This field laboratory, confronted with the foregoing situation, is conducting studies to determine whether the livestock and pasture can be improved profitably.

Livestock and Pasture Improvement Investigations

After three years of intensive investigation at this Station there are good indications that the characteristic slow development and stunted appearance of East Texas livestock can be overcome through the improvement of pastures. There are too many periods throughout the year, on the average unimproved pastures and ranges, when the livestock are not getting sufficient nutritious forage to keep them in a thrifty or fattening condition, thus causing loss of part if not all of the weight the livestock have gained during periods when sufficient nutritious forage is available.

These indications have grown out of various studies with Hereford cattle on improved pastures. The first study made on this problem of slow development was to try to determine whether or not there was a deficiency of some mineral necessary to proper development. Several minerals were selected for study of which deficiencies had been reported in other states and countries. These minerals were supplied daily to the cattle. During the three years of this study only slight gains were obtained, and it was soon noted that the cattle used for check or those receiving no mineral other than salt attained normal size for Herefords and were thrifty on the average. While this mineral test was in progress, it was necessary to use improved pastures for grazing with the different lots of cattle being grazed together or as one herd. Early in the development of the pastures, their productive period was not much greater than unimproved pastures, but after three years they are furnishing around 270 days of profitable grazing or approximately twice as much as those unimproved. While these pastures were furnishing grazing, the cattle including those not receiving any mineral, were usually in a good, thrifty, growing condition. Thus the indication that if the period of nutritious grazing in this part of the state is prolonged sufficiently through improving the pastures, livestock will attain normal development.

Further to bear out the point that the forage is more nutritious on the improved pastures than on the unimproved, upland, timbered pastures forage samples were analyzed chemically from time to time with the following results: The improved pasture forage contained approximately 11 per cent protein, .80 per cent lime, and .40 per cent phosphorus; whereas the unimproved forage contined 7 per cent protein, .40 per cent lime, and .20 per cent phosphorus. It is interesting also to note at this point the difference in yield between the two kinds of pastures. The improved pasture produced 7034 pounds of air-dry forage per acre during its productive period as compared to 2010 pounds for the unimproved pasture while it was in a productive stage.

During the three years that the Herefords were on mineral test, they were also observed closely to determine what influence internal and external parasites might have on retarding growth of the cattle. The results of these obesrvations indicate that internal parasites are not an important factor, and with the exception of ticks that the external parasites are also of no importance. Ticks, especially fever ticks, will no doubt stunt livestock, if not cause their death, but it has been noted that livestock in areas cleaned of the fever tick, although still grazing on unimproved pasture, are not as large and thrifty as they should be. Therefore parasites in general do not appear to be a major factor in causing stunted growth.

We have improved the pastures or lengthened the productive period, increasing the yield and quality of the pasture forage through: (1) the establishment of desirable grasses and clovers, (2) the proper management of these forage plants after establishment, and (3) the application of fertilizers. The most desirable forage plants in our pastures at present are White Dutch, Hop, and Persian clovers; Carpet, Dallis, and Bermuda grasses; and common lespedeza. Those plants that have been most responsible for lengthening the productive period are the clovers, which furnish grazing in the late winter and early spring before forage on unimproved pastures is available. Those plants that have played a leading part in raising the nutritive value of the forage are the clovers and lespedeza. Proper management of the pasture forage, especially the grasses, that is, keeping them grazed or mowed closely and thus in a growing succulent condition, has been another factor in increasing the nutritive value. All three of the means listed above for improving the pasture have probably been equally responsible for the increased yield of forage over that of unimproved pasture land.

Other Beef Cattle Studies: An effort to improve beef cattle in this region by using better beef cattle blood, along with their desirability for the study of deficiencies, resulted in the shipping in December, 1934, of a bull and twenty-nine Hereford heifers at weaning age.

After going into the year with twenty-seven coming three-year-old heifers averaging 872 pounds due to calve in March, and a bull of the same age weighing 1405 pounds, we had on hand at the close of the year forty-four head composed of twenty-six coming-four-year-old cows bred to calve in April, 1938, and averaging 887 pounds; eight bull calves, dropped in March and April and averaging 483 pounds; six heifer calves dropped during the same time and averaging 411 pounds; one steer of the same age but lighter in weight; two summer calves; and the coming-four-year-old bull weighing 1530 pounds. One light weight bull calf was sold at weaning time. Twenty-four normally developed calves were dropped, two were aborted prematurely. Only one cow did not breed. One of the six full-time calves that were lost was born dead; three others were born alive but suffocated soon after birth, cause unknown; and the other two were killed by dip being too strong. The cause of one of the two calves being dropped prematurely was thought due to dipping the cow when heavy with calf. The cause of the other abortion was unknown. Tests for Contagious and Trichomonas Abortion were made on all cows losing calves except those whose calves were lost from dipping. Neither disease was found. Reports that other cattle raisers in this region had lost calves in a similar way (suffocation soon after birth) indicates that the trouble is not necessarily confined to Herefords.

An attempt to winter the heifers on two or three pounds of cottonseed cake and Southeast Texas hay while they were running on timbered upland pasture failed because several became constipated and lost weight rapidly. The unusually continuous rainy weather during January and February probably aggravated this condition. The heifers were brought back to normal only by resorting to full feeding and including alfalfa hay in the ration. This constipated condition was not confined to the Station Herefords, however, because neighboring stockmen reported the same condition in their native and Brahman cattle. It does indicate that something more than "cake" and prairie hay will be necessary for wintering Hereford cattle without loss in this region when rainfall is prolonged over a part of the winter.

It was necessary to assist probably 40 per cent of the cows when they calved because of unusually large calves. This condition could not be fully explained; however, the heavy feeding of the heifers just prior to calving may have caused the extra growth of the calves.

One cow died in July from what appeared to be forage poisoning. She was grazing at the time on the same timbered pasture where two cows were lost from a similar cause in July, 1935. The plant that is causing this trouble is evidently poisonous at only one stage of growth. Searches have been made for the plant, and several doubtful plants found, but no definite information has been obtained.

Pen breeding was started July 1 this year, a month later than last year. The reason for this change was that because of the usual rainy, disagreeable March weather and of the lack of sufficient green forage at this time, April seemed to be a better month for calving. Considerable trouble was encountered this year in getting the cows to conceive. Some of the cows were served through four or five heat periods without conceiving. This same trouble has been reported by local dairymen this year, who claim it to be relatively new. Therefore a very low percentage calf crop is expected for next year.

Another trouble encountered during calving time was with the cows retaining the afterbirth. Mechanical removal was necessary in several cases. Since this abnormal condition seems to be unusually general throughout East Texas, it deserves a systematic study by veterinarians.

Starting in May, the calves have been fed continuously on a ration of oats, corn, and cottonseed meal. By the latter part of December, feed for these calves per head had cost $8.80. Spring and fall vaccinations of the calves for blackleg and hemorrhagic septicemia should prevent loss from either of these diseases. Early weaning of the calves failed to cause a gain in the cows; thus winter feeding was necessary by November. By the end of the year, feeding of cottonseed cake, fed in amounts considered adequate elsewhere, along with various roughage, had not prevented small losses in weight from the early fall period.

During most of the year, grazing was furnished these cattle by improved creek-bottom pasture, and the remainder of the time by the unimproved, upland, timbered pasture.

The cattle, especially the cows, heated seriously during the summer months, while grazing in open bottom pasture, and it became necessary to arrange for shades. The indications are that this excessive heating was caused by the dipping program which has been in effect since May. If dipping is not the cause, then breeding herds of Herefords must have shade available in the East Texas Forest Region.

A few cows exhibited symptoms of internal parasites this fall; therefore droppings were collected and examined for parasite eggs. None were found. Similar examinations made a year previously gave the same result. Thus internal parasites do not appear to be a serious problem in East Texas.

Mineral Deficiency Studies: A continuation of the supplying of copper bears out the results obtained by supplying it in 1936, although not so conclusively. In April, sixteen cows with calves were divided equally as to weight of the cows and sex of the calves to check for a copper deficiency. The cows in one lot were force fed three ounces of bonemeal daily and those in the second lot were given the same amount of bonemeal plus a dose of a .2 per cent solution of copper sulfate at the rate of 25 c. c. per 600 pounds live weight. After five months, the cows in both lots had lost weight but in approximately the same proportion. On the other hand, the calves whose mothers received copper had gained ten pounds more per head during the period than those whose mothers received only bonemeal.

At weaning time the cows were dropped from the test and the calves given the same minerals as their mothers. This part of the test will not be concluded until next spring.

Other Pasture Improvement Studies

Bottom Experimental Pasture Areas: The fall of 1936 planting of White Dutch clover, Hop clover, and Rescue grass and the application of phosphate at the rate of 300 pounds per acre gave the following results: The clover planting was very profitable, with the White Dutch predominating. The entire forty-two acres were well covered, and produced enough surplus above the grazing of over forty head of cattle for 150 bales of hay. Reseeding was plentiful. These clovers also shortened the long winter period by three or four weeks. The Rescue grass planting was not profitable, with only a very light stand being obtained from a seeding of ten pounds per acre. The phosphate treatment was not checked, but no doubt played an important part in the luxuriant growth of the clovers.

In a search for any kind of forage plant that will serve to shorten the winter period, Persian clover was planted this fall because of its reported earliness. So far only a light germination has been obtained from the five pounds rate of seeding. Phosphate was applied again this fall at the same rate as last fall. Check areas were left for this application.

This year the forty-two acres of improved pastures furnished cow days grazing for the Station herd of Herefords in the following manner: January, 175; February, 445; March, 557; April, 789; May, 893; June, 843; July, 816;

August, 962; September, 920; October, 972; November, 548; and December, 270 cow days. This gives a total of 8190 cow days of grazing for the year as compared to 7252 for 1936. If this pasture had carried all the cattle continuously throughout the year, it would have furnished approximately 11,656 cow days of grazing. However, supplemental feeding was necessary during the winter and fall. In the winter the supplemental feeding was considered heavy.

Gains of these cattle on the improved pasture varied in general from high gains in the spring and early summer to loss of weight in the late summer and fall. However, the cattle were maintained in thrifty condition throughout the year, except in January and February.

Through the majority of the growing season forage samples for yield and chemical analysis were obtained on the pasture. The forage was mowed three times during the year, with the first and part of the third cuttings being saved for hay. Approximately 200 bales were saved for winter use in this manner. Therefore the total yield for the pasture in this year was 8190 cow days of grazing and 200 bales of hay.

Grasses and Legumes for Observation: Approximately 110 forage plants, both new and adapted to the East Texas Forest Region, were cultivated throughout the year and their reaction to the climate and soil noted. Some of the more promising annuals that reseeded in 1936 were replanted this year for further observation. Only two grasses that had not been tried previously were added this year; i. e., Texas Blue Grass and Cheat or Chess. They were planted in October, and so far their growth would have furnished very little grazing. However, none of these plants have exhibited the necessary qualities to compete with indigenous forage plants.

Those grasses listed in the 1936 Report as being the most promising continued to hold their rank this year, except Paspalum conjugatum. Only a small per cent of the plants of this grass recovered from the winter period. None of the legumes being grown show to be as desirable for use in permanent pastures as White Dutch clover or Common Lespedeza. As a perennial winter grass Agrostis scabriglumis still has some promise, although Phalaris angusta, previously reported as having promise as an annual winter grass, does not make as much growth under cultivation as winter oats. Even though it makes seed, the viability of these seed is evidently low, since no plants could be found this fall resulting from the previous fall planting.

Sod Introduction Test: This test was started in 1934 with some perennial grasses added in 1936. The plantings and transplantings were made on upland, Carpet, and Bermuda grass sod without any cultivation or protection before grazing. Out of the twenty-five grasses and clovers included, only the perennial grasses and three of the clovers were in evidence this year. These plants had spread little, if any. No fertilizer was applied in this test.

Grazing Test for New Forage Plants: Seven grasses, Calomagrostis, epigejos, Digitaria polevansii, D. eriantha var. stolonifera, D. Pentzii, Cynodon barberri, C plectoistachyum, and a Festuca specie, almost disappeared this year under continuous heavy grazing and while growing in competition with Bermuda and Carpet Grass. These grasses were selected from the forty or fifty different species being grown under cultivated conditions. They were cultivated and protected from grazing after transplanting until they had become established. Then goats, horses, and cattle were turned in and cultivation of the plants stopped.

Chemical Analysis of Permanent Pasture Plants: Samples were collected at random over the Bottom Experimental Pasture Areas daily from June through November. The sample represented as nearly as possible what the cattle were grazing. The daily samples were then combined by the calendar month. The average composition of these monthly samples was: protein-11.4, fat-2.31, crude fiber-25.63, N. F. E.-43-.25, water-8.03, ash-9.29, lime-.80, phosphoric acid-.43, insoluble ash-5.18, and potash-1.18 per cent.

Inoculation Test on Permanent Pasture Legumes: In a fall planting of both Hop and White Dutch clover on the Bottom Experimental Pasture Areas, all the seed were inoculated except in the planting of a small check area. This spring there were decidedly more nodules on the Hop clover plants that were inoculated and little difference between the inoculated and non-inoculated White Dutch plants. No difference could be noted between the treatments as to health and growth of both clovers. Over a period of one week the forage mixture on the non-inoculated area produced 1360 pounds per acre and that of the inoculated produced 1400 pounds per acre. This test makes previous reports, that inoculation is not necessary, especially for White Dutch Clover, still more conclusive.

Woodland Pasture and Timber Investigations: The timber was measured for growth twice during the year by the Texas Forest Service. Forage samples were gathered periodically in the areas containing the lowest number of trees, but the production was very light and of low quality as compared to the improved pastures. Similar samples gathered in 1936 and analyzed this year showed the following averages: Area 1 (175 trees per acre): protein-7.63, fat-2.67, crude fiber-30.51, N. F. E.-44.35, water-6.59, ash-8.35, lime-.40, phosphoric acid-.23, insoluble ash-5.39; Area 3 (285 trees per acre): protein-7.15, fat-3.00, crude fiber-30.95, N. F. E.-42.82, water-6.96, ash-9.12, lime-.44, phosphoric acid-.25, and insoluble ash-6.30 per cent.

At this point it is important to note the difference between the yield and chemical analysis of the unimproved upland timbered pasture and that of the improved creek-bottom pasture. While the timbered pasture produced only 2010 pounds of air-dry forage per acre, the improved pasture produced 7034 pounds during the same period. The analysis of this forage showed that where the unimproved timbered pasture had approximately 7 per cent protein, .20 per cent phosphoric acid, .40 per cent lime, the improved pasture forage contained approximately 11 per cent protein, .80 per cent lime, and

.40 per cent phosphoric acid. This information should help to explain the low carrying-capacity of unimproved pasture land in this area. It should also help to explain the lack of development of cattle grazed on such pastures.

Fertilizer Test on Native Pasture: In order to study response of native pasture forage (mainly Bermuda and Carpet Grass and Common Lespedeza) to fertilizer, an application of seven different fertilizers in four replications was made this spring on average native open pastures. Four clippings were obtained between the beginning (May 5) and ending (September 25) of the test for the year. Each treatment produced more forage than the check, ranging from an increase of approximately 300 lbs. of green forage per acre over the check for the treatment 35-116-24 to 1800 lbs. over the check for the treatment 70-58-24. The check replications averaged 3539 lbs. per acre. Based on yield alone, it is doubtful that the application of any of these fertilizers was profitable, unless the increased yield caused by the application continues over a period of years. For this reason the test will be prolonged for several years. The qualitative basis for measuring the profitableness of the fertilizer is less tangible than that of the yield. It is thought that the percentage of desirable grasses will increase as the test continues, thereby increasing the nutritive content of the forage as a whole. The percentages of the forage plants on the test plats were estimated at the beginning of the test and will be similarly estimated yearly. Chemical analyses of forage samples from the different treatments were not obtained this year.

Oak Ashes on Native Pasture: It has been noted that Bermuda grass and White Dutch clover are seldom growing in timbered pastures in this area except around old burns where considerable ashes were left. Therefore it was deemed important to see just what response could be obtained from an application of ashes on open native pastures. Ashes are also plentiful around saw mills in the forest region, and could probably be obtained gratis to the farmer, if experiments indicated they had value for pasture improvements.

Oak ashes were applied by hand as a top dressing at the rate of two tons per acre. Four replications were made, and three cuttings were obtained from June 10 through September 26. The check plats averaged 4,006 pounds of green forage per acre for the period and the plats receiving the ashes, 4,740 pounds or an increase due to the ashes of 734 pounds per acre. The type of forage covering was the same as that of the Native Fertilizer Test. Some improvements of the forage in quality was no doubt caused by the ashes, but this could not be measured satisfactorily.

Effect of Mineral Fertilization on Establishment and Survival of Clovers on Native Pasture: White Dutch, Persian, Cluster, Subterranean, and two Hop clovers were planted on a Carpet and Bermuda grass sod in 1936. Lime at the rate of two tons, potash at the rate of 100 pounds, and phosphate were added at rates varying from none to 1000 pounds. The test was laid-out in such a manner that the effect of each of the fertilizers on each clover could be checked. This test was located in a pasture subjected to heavy continuous grazing; therefore it was not possible to obtain yield data, but from observations there seemed to be little difference due to fertilizer treatment or little differences in the amount of grazing furnished by the clovers. The test area was fenced this fall so that controlled grazing can be practiced, and all clovers that were grazed too closely in the spring for sufficient reseeding were replanted.

Effect of Differential Phosphate Applications on Adaptation of Different Strains of Subterranean Clover: The Commercial, Mid-season Mt. Barker, and Extra Early Dwalganup strains were used in this test. Rather heavy seedings were made by hand in the fall of 1936, and phosphate at the rate of none, 200, 400, 800, and 1200 pounds was added. The test failed to show any marked results this year for the same reason as the preceding experiment; however, reseeding was sufficient and the test will be continued. This area was also enclosed in fence. At present, the advantage that Subterranean clover seems to have over the other clovers tested is that it is the first to furnish grazing in the fall.

Winter Pasture: The planting of hairy vetch, oats, and Italian rye grass as set forth in the 1936 report was rather disappointing in that none of the forage made sufficient growth for much grazing during December, January, and February, when it was most needed. Also the pasture was usually too boggy for grazing when the growth was sufficient. The old, upland-field land on which this test was located was well fertilized at the time of the planting with sulfate of ammonia, cottonseed, meal, and manure.

This fall the area was again planted with oats, hairy vetch, White Dutch clover, and Yellow Melilotus. No fertilizer was added. By the end of the year only two days grazing had been obtained for twenty-six head of cows.

Forage samples for yield and chemical analysis have been collected on this pasture.

Summer Pasture: Sudan Grass was planted in May after the residue of the winter pasture was turned under. This attempt was also rather disappointing, since only a relatively few days of grazing were furnished and the surplus growth was not enough to justify cutting for hay for winter use.

The Sudan was planted with a drill, thus eliminating cultivation, which is evidently necessary in this area where weeds make such a fast growth.

Miscellaneous Studies Pertaining to Pastures: One-half acre each of Schrock and Leoti sorghums was planted this year in three foot rows with the following results: Each produced slightly over five tons of headed bundles per acre, but the Schrock produced 1600 pounds of heads per acre as compared to 1050 pounds of Leoti. However, the Leoti was more free of disease and made brighter feed. Sulfate of ammonia at 200 pounds per acre was applied as a side dressing.

As a preliminary step toward ensiling grass, two small amounts of grass (mainly Carpet and Bermuda) were placed in the ground, trench-silo fashion, and tramped. To one was added only water and to the other water and molasses. Neither sample kept.

In trying to answer the often asked question about whether pasture sod in this region should be plowed up occasionally, we disced an acre on tight native upland-pasture sod on May 7, 1937 with the following results: The per cent of grasses was decreased, the per cent of sedges and rushes was increased, the gemination of Lespedeza was decreased, and the per cent of barren space increased.

Forage samples from the fertilizer applications on the Bottom Experimental Pasture Areas from which the yield data was reported last year, were analyzed this year with the following results: There were no marked differences between samples from any of the treatments and that of the untreated. The percentages of protein, lime, and phosphoric acid were approximately 10.5, .70, and .38 respectively.

These analyses indicate that pastures on creek-bottom land containing a mixture of Carpet, Bermuda, and Dallis Grass along with the lespedezas and the clovers do not require fertilizer treatments.

Sugar Cane Studies

Variety Tests: On bottom land, improved varieties, C. P. 29-320, C. P. 28-11, C. P. 807, C. P. 28-19, P. O. J. 213, P. O. J. 234, P. O. J. 36M, Co. 290, and Co. 281, all produced more sirup per acre than the Native or Louisiana Purple variety. This variety produced only forty-six gallons per acre and none of the improved varieties produced less than 100 gallons, with the highest yield 204 gallons for Co. 290.

On poor upland soil, but with the help of fertilizer, the same varieties produced slightly less sirup per acre. However, the proportional differences were about the same. The yield ranged from forty gallons per acre for the native to 198 for the Co. 290 Variety.

Fertilizer Test: A 1936 application of 4-12-4, with one-half the nitrogen in cottonseed meal and one-half in nitrate of soda, at the rate of 500 pounds produced eighty-four gallons of sirup per acre more than the untreated cane. The other five treatments produced from twenty-eight to seventy-one gallons more sirup than the check. This test, which was carried over from last year without modification, the cane being grown from stubbles, indicates that the fertilizers used are more valuable the second than the first year.

E. K. Crouch.

SUBSTATION NO. 12, CHILLICOTHE

Substation No. 12 is located four and one-half miles south and one mile west of Chillicothe, Hardeman County, longitude 99 degrees west and latitude 34 degrees north, and elevation 1406 feet above sea level. The Station serves a region in the northern part of the Rolling Plains area in which the Vernon, Foard, Abilene, and Miles soils predominate. The average annual rainfall at this point is almost 25 inches.

The Station was established in 1905 on leased land as a forage crop testing station operated by the United States Department of Agriculture and the Texas Agricultural Experiment Station. The cooperation has continued to the present. In 1916 the State of Texas purchased 100 acres of land which comprise part of the present Station. During the present year an additional 122 acres were purchased by the State, making the present area 222 acres. The Station in addition has the use of a 30 acre tract that was bought by Hardeman County at the same time the State made the purchase of 122 acres. The total area of the Station is therefore 252 acres.

During the early years an important phase of the work consisted of testing crops recently introduced from foreign countries and resulted in the introduction and distribution of Sudan grass and the now important varieties of grain sorghum, feterita and hegari.

In common with all others, this Station is collecting reliable information on the proper procedure in crop production and soil management. Varietal and cultural experiments are being made with the important crops. Some attention is being devoted to vegetables and fruits for production in home gardens and orchards and to ornamental plantings of trees and shrubs. The unique feature of the work at this Station is the investigations under way with sorghums. The most complete nursery of both forage and grain types of sorghums in the United States is maintained at this point. An intensive study of sorghum inheritance is under way and the production of new and superior varieties is the aim of an inclusive plant breeding program.

Cotton

Cotton Variety Test: Production was the best that has occurred since 1933. Lankart was the variety of greatest production, followed closely by Mebane No. 140. These two varieties produced over 510 pounds of lint cotton to the acre. The third variety in point of yield was Mebane No. 141, which produced 468 pounds of lint. Half and Half produced 430 pounds to the acre. Roger's Acala and Acala No. 8 produced between 380 and 390 pounds of lint. During the five year period, 1933 to 1937 inclusive, the four high varieties in point of yield are Mebane No. 140, 322 pounds and 15/16 inch staple; Western Wonder, 303 pounds and 7/8 inch staple; Half and Half, 295 pounds and 13/16 inch staple; and Mebane No. 141, 278 pounds and 15/16 inch staple.

Date of Planting: For the fourth consecutive year a very serious drought occurred in August. The drought was not as severe at this point as were the droughts of the preceding three years, because a rain of 1.44 inches fell on July 20. This rain was not enough, however, to prevent damage to the April and May plantings, but the June planting bloomed freely and shed very little during the entire summer. During recent years there has been a tendency for the earliest cotton to be the best in production, but in 1937 the trend was very decidedly in the opposite direction. The yields for the different plantings were: June 15, 482 pounds; May 15, 294 pounds; and April 15, 148 pounds.

Control of the Cotton Flea Hopper: Proper provision was not made early enough to control the very serious infestation of the cotton flea hopper that occurred this year. Cotton was dusted twice after the infestation developed, the first dusting being done on July 24 and the second on August 5. The first dusting was done with sulphur somewhat coarser than is recommended, and the second remained on the plants only about ten hours before it rained. Nevertheless, there was a difference in production of 44 pounds of lint to the acre, the figures being 345 pounds on the dusted and 301 pounds on the undusted plat.

Cotton breeding: Selection within the strain of Mebane Triumph cotton that was grown prior to 1920 has resulted in the isolation of two strains, Nos. 140 and 141, that have been distributed. In the variety test strain No. 140 has been the variety of highest production, exceeding Half and Half by 9 per cent, and has produced an average staple length of 15/16 inch. Half and Half has produced an average staple length of 13/16 inch during the same period. Strain No. 141 has produced a greater yield than any commercial variety except Half and Half. If the present discrimination against short cotton continues, it is possible that one, if not both, of these Mebane strains will become important varieties in this section of the State. These two strains have both been adopted by commercial seed firms. The Station will continue to maintain pure stocks of each.

The cotton breeding work under way at present involves selection from the progeny of a cross between Lankart and a strong fibered strain of Mebane. This strain of Mebane, along with strains 140 and 141, was isolated in the straight selection breeding program that has been completed. The third hybrid generation of this hybrid was grown in 1937 and a number of promising plants appeared.

Corn

Hays Golden, a very early maturing variety of corn, was the variety of greatest production in the variety test. Yields were the best that have occurred in several years, with all of the adapted varieties producing in the neighborhood of twenty bushels per acre.

Breeding work continued with Golden June corn for the purpose of increasing production and Vitamin A content.

Sorghums

(In cooperation with Bureau of Plant Industry, U. S. D. A.)

Yields in 1937 were the best recorded since 1933. Average yields or better were obtained from all plantings from April 15 through June 15. The striking thing about the variety test this year was that milo for the first time in many years showed its old-time superiority in yield. The inclusion of blight resistant strains in the test accounted for this condition.

Sorghum breeding: Over 500 progeny rows of Blight Resistant Dwarf Yellow milo were grown in a continuation of the effort to recognize the best of the 800 Runnels County selections. In all likelihood the best strain will be found after the work of one more year.

Resistant strains of Early White milo and of Quadroon were obtained from a planting on diseased land in 1937. Suitable crosses were made to to obtain this early, yellow seeded strain.

Work was continued in the production of a sorgo with palatable grain and resistance to foliage diseases. Strains satisfactory in all respects except for resistance to foliage diseases have been obtained by backcrossing a sumac x kafir hybrid several times to sumac One of the backcrossed strains has been crossed to Leoti for the purpose of selecting for foliage disease resistance in the progeny.

Palatability of sorghum grain: The connection between the genetic seed characters presence or absence of the nucellar layer, the presence or the absence of the spreader, and the presence or absence of pericarp color with tannin content of the seed has not been established, possibly because of the difficulty of making exact quantitative chemical analysis for tannin. Nevertheless it has been established by a feeding test to farm animals that it is possible to obtain sorghums very similar to sumac or Darso in other respects but having palatable seeds.

To obtain an indication of palatability of heads among some of the promising hybrid strains which are approximately stable for all characters, twelve pounds of heads of each of several strains were weighed out and fed to the Station mules in comparison with like amounts of heads of common varieties. These mules were well fed with stover bundles which contained occasional heads, and they had access at all times to their regular feed which was a mixture of ground grain of grain and sweet sorghums with 5 per cent of cotton seed meal added.

The head samples were placed in the feeding trough at 10 A. M. and the unconsumed remainders were removed and weighed at 6 P. M. the same day. The varieties and strains fed and the per cent of the 12-pound samples consumed in eight hours are tabulated below. The Chiltex x hegari hybrid was consumed completely before Chiltex was all eaten.

Variety and Remarks	Per Cent of 12-lb. Sample of Heads Consumed by 6 Mules in 8 Hours
Yellow milo, yellow-seeded, nucellar layer absent	93.0
Sumac, red-seeded, nucellar layer present	65.9
Kafir x sumac, red-seeded, no nucellar layer	95.3
Darso, red-seeded, nucellar layer present	23.3
Kafir x Darso, white-seeded, no nucellar layer	84.1
Kafir x Darso, yellow-seeded, no nucellar layer	93.8
Chiltex, white-seeded, nucellar layer present	100.0
Chiltex x hegari, white-seeded, nucellar layer present	100.0

Sudan grass breeding: Segregating populations of the second backcross of Leoti x Sudan to Sudan were grown in 1937. Desirable plants with the desired glume colors were obtained. Certain of these plants approached Sudan grass type closely and this breeding work is progressing satisfactorily.

Hybrid vigor in sorghum: A paper on male sterility in sorghum was published during the spring of 1937, and in this paper it was pointed out that one of the three problems that needed solution before the use of hybrid sorghum could become a commercial reality was that of getting good sets of crossed seed on male sterile heads. After the work of the summer it is apparent that this is a problem not impossible of solution. Excellent sets of crossed seed were obtained on male sterile heads that by inheritance have long feathery stigmas, particularly in the late part of the season. It appears that sorghum pollen is sensitive enough to low humidity and high temperatures or both so that much of it is damaged before fertilization takes place when blooming occurs at mid-summer. The indications are that the bulk of the crossed seed may ultimately be obtained from branch heads rather than from the main heads that emerge first. Dwarfness of the male sterile plants very obviously enhanced the opportunity of obtaining good sets of seed.

Inheritance studies of characters in sorghum were continued and one paper showing the relationship between the three linked genes for glume or plant color, nucellar layer, and green striped was submitted for publication during the year.

Small Grain

(In cooperation with Bureau of Plant Industry, U. S. D. A.)

Wheat varieties: Yields above 20 bushels per acre were obtained this year. As is usually the case there was little difference in production between the varieties commonly grown in this area such as Kanred, Blackhull, and Tenmarq. The fourteen year average of the three varieties is the same, 22.2 bushels per acre.

With the purchase of an additional acreage of land, the major portion of which is excellent soil for wheat, it is going to be possible and desirable to expand the work with wheat and barley. As a matter of fact, extensive plantings of wheat and barley breeding material obtained from the Denton Station were made in the fall of 1937.

J. R. Quinby, J. C. Stephens.

Ornamental Plantings

The plantings of trees and shrubs on the Station include 131 species and most of the adapted species suitable for this purpose are included. These plantings which are not given special care but are by common cultural methods protected from undue competition from grass and weeds, show what may be done in this area without prohibitive cost, if proper plans are made and suitable species selected.

J. R. Quinby.

SUBSTATION NO. 14, SONORA

(Ranch Experiment Station)

Substation No. 14 is located on the Edwards-Sutton county line; it comprises approximately the north half of sections 62 and 69 in Sutton County, with the south half of these sections, sections 63 and 64, and the east half of sections 45 and 46 in Edwards County. The Station headquarters is located near the center of the south side of Section 63 in Edwards County, one third mile north of Highway No. 55, 28½ miles from Sonora and 29 miles from Rocksprings. The latitude is 32 degrees north and longitude 100 degrees west; the elevation is approximately 2400 feet above sea-level. The average annual rainfall over a period of 18 years is 25.31 inches. This year shows 8.27 inches less than average. The Station lands consist of 3461.63 acres. Sixty acres are in cultivation for the production of feed crops while the balance is used for grazing purposes.

The Station was established for the purpose of serving an extensive area known generally as the Edwards Plateau region, where livestock is the predominating agricultural resource. Sheep, goats, and cattle are the principal livestock of the region. This region produces the great bulk of the sheep produced in Texas, which ranks first of all the states in the number of sheep and the quality of wool produced. The region also produces the great bulk of the Angora goats, which yield 86 per cent of the nation's crop of mohair.

Studies in diseases of livestock, particularly the diseases of sheep and goats, constitute an important phase of the Station's activities, inasmuch as these occur under range conditions where, unlike other sections, loose herding is quite generally practiced. The study of external and internal parasites affecting livestock is another important line of work. Other problems relate to the study of the forms of vegetation that make up the range feed value, the number, diversity, and occurrence of these different species, and the sequence in which they occur and contribute to the total carrying capacity of the range.

Still other important problems embrace the study of the inheritance of desirable and undesirable characters in sheep and Angora goats and the production problems of the livestock of the region.

Cultivated Crops, Shrubs, Flowers, and Vegetables

Sixty acres of land are in cultivation for the production of feed for livestock. Sorghums constitute the main crop. This year approximately sixty tons of silage and fourteen tons of maize heads were raised and harvested. The silage will be utilized during the lambing and kidding operations or preserved until more adverse range conditions exist. Records for feed crops planted here show excellent yields four to five years out of each five or six.

No experimental work is done with vegetable gardens, but the residences on the Station have been able to produce early spring and fall crops of radishes, spinach, onions, beans, beets, carrots, okra, turnips, and potatoes. Tomatoes are invariably killed out by a disease believed to be wilt. These gardens are produced by surface irrigation.

The most satisfactory flowers grown here seem to be sweet peas, chrysanthemums, zinnias, various bulb plants, morning glory, and castor beans.

The introduced shrubs on the Station, including privet, arborvitae, juniper, cypress, and Nandina, have grown satisfactorily and have greatly improved the landscape. The plantings of yucca, cacti, senecia, and huajillo, which are native, have been well established in some of the yards. More native shrubs as rosin bush and rubber plants have been planted. Root rot killed the rosin bushes.

Prickly Pear Eradication

During the past few years prickly pear has been encroaching on the sheep and goat ranges of southwest Texas to the extent that it is becoming a menace. The increase on the Ranch Station has been from 16 plants to 31 plants per acre. It has long been known that some cattle would become chronic pear-eaters throughout the year if they were fed on the plant to some extent during the winter, but it has not been a great source of trouble among sheep and goats until the past four or five seasons. Sheep and goats begin on the new spring growth of the plant and continue eating throughout the summer, regardless of the season or condition of other desirable vegetation. The spines on the plants prick their mouths and produce sores which make them readily susceptible to screw worm infestation. These conditions exist on a large number of ranches in the Edwards Plateau region, and the owners are eager for information as to how prickly pear problems can be solved.

This Station, working in cooperation with the Division of Agricultural Engineering, set out in January, 1933, to determine the best method of prickly pear control. Spraying and stabbing the plants with various chemicals and poisons at different times of the year was first outlined. Equipment for the work had to be devised and made. The proper time to kill the plants by poisoning is during the summer months. The most satisfactory poison found thus far is 2½ pounds of arsenic pentoxide dissolved in one gallon of water to which is added ½ pint of commercial sulphuric acid. In 1934 the cost of applying this solution with an Australian atomizer on 781 prickly pear plants, or an average infestation per 25 acres, was 13⅓ cents per acre for labor and material. The price of 97% pure arsenic pentoxide in this test was 37 cents per pound. A recent quotation on arsenic pentoxide 84% pure is 11 cents per pound for an imported product. At the latter price the cost of poison for prickly pear eradication should be within the reach of all interested users.

Livestock have been left in the pastures where the poisoning tests have been conducted. Extreme care has been exercised in keping the poison off all vegetation except the prickly pear, with the result that we have not experienced trouble from arsenic poisoning in livestock. However, it is not to be recommended that the stock be left in the pastures where poisoning work is going on.

W. H. Dameron, H. P. Smith.

Spineless Cactus (Opuntia Ellisiana)

Because of having exhausted our supply of spineless cactus during 1934-1935, no additional feeding tests have been conducted. Also a considerable amount of disease (Sun scald and anthracnose) did much damage to about seven acres of our cactus, with the result that it was plowed up. Two attempts have been made to replant this acreage. They have been unsuccessful in that after the plants or slabs had taken root, disease again struck, which killed 60% of the new plants. The area is to be used for sorghum production for about two years before it is planted to cactus again.

W. H. Dameron.

Bitterweed Control

Bitterweed germination in the fall of 1936 was tremendous on all areas not well covered with grass sod. There was also a heavy germination in the grass sod, but these weeds did not make the growth that the weeds did where competition for soil moisture was lacking.

A considerable amount of bitterweed trouble (poisoning) began in December, 1936, in sheep and continued until March, 1937. This condition is attributed to lack of variety of desirable succulent winter forage plants and a considerable amount of accidental eating of bitterweed seedlings that are present in the grass turf. The ranches that are experiencing trouble are having to move their sheep off bitterweed to territory where there is not any. This incurs a heavy expense to stockmen.

Bitterweed spread extensively during 1935 and 1936 on account of the heavy rains and flood conditions experienced those years. Seeds of the plant were carried down the drainage areas and deposited along the banks of the draws and streams where it had not been present before. Those seeds thus transported and deposited germinated and resulted in a weed menace except where the ranchmen realized the seriousness of the situation and destroyed the bitterweed plants as they appeared on their premises.

Lighter stocking of the range where bitterweed is a menace or threatens to become so offers considerable encouragement in the form of control. In 1931 the Ranch Station reduced its stocking capacity from 64 units per section to 50. At that time three quadrat counts showed a bitterweed infestation of 5,800,000 plants per acre. In 1936 these same quadrats had an average infestation of 500,000 plants per acre or a reduction of little over 91%. Grass cover is increased many fold.

To gain some information on excluding livestock from definite areas to eradicate or control bitterweed, three small exclosures were made in 1931 in three different pastures and under three different conditions. The bitterweed infestation on these areas averaged 5,155,878 plants per acre. In 1936 these same areas had 60,705 plants per acre or above 99½% decrease. Increased grass and other desirable forage cover is pronounced; in fact, it has replaced bitterweed.

Old lake beds and depressions where water stands are considered bitterweed hazard areas. A number of such areas were planted to rye grass in late summer and early fall 1937. An excellent germination was obtained and it appears this method of combat offers something of value in control of the bitterweed pest.

Animal Breeding and Production

Mineral Feeding: The question is frequently asked in this region if there is any benefit to livestock from feeding mineral in the salt lick. In an effort to give accurate information on this subject, this Station has had grasses and forage plants analyzed for feed value and mineral content all months of the year. To supplement this information, in June, 1934, the Hereford cattle comprising 54 head were divided into two groups, and the grade Rombouillet ewes comprising 300 head, into two equal groups. One group of each class was placed in one pasture on a 50% bone meal and 50% salt mixture, and the other group was placed on plain salt in an adjoining pasture. Individual weights of the animals were taken at the beginning of the test. An accurate record of the consumption of salt and bone meal has been kept for the respective groups. The animals have been alternated in the pastures every thirty days, complete production records have been kept, and in addition specified individuals of each group of cattle have been used for blood analysis tests in the spring and fall of the year. This year the bone meal-salt group cows raised seventeen calves with an average weaning weight of 391.5 lbs., while the plain salt cows raised eleven, with an average weaning weight of 388.30 lbs. On account of not getting any higher production of wool and lambs from the mineral group of sheep as compared to the plain salt group, sheep were dropped from the test this year.

W. H. Dameron, O. L. Carpenter.

The Inheritance of Polled Rambouillets

In the fall of 1936, 62 head of ewes were bred to six polled rams. Forty-one lambs were weaned from the sixty-two ewes in the fall of 1937. Results will be found in the report of the Division of Range Animal Husbandry.

B. L. Warwick, W. H. Dameron.

Adaption of Corriedale Sheep to Southwest Texas Conditions

Twenty-one Corriedale ewes were bred to a registered Rambouillet ram for the work this year. Fourteen of the ewes dropped lambs which is 66.67% lamb crop as compared with 70.11% for the registered Ramboullet ewes. The average weaning weights of the cross-bred Corriedale-Rambouillet ewe lambs was 58.3 pounds as compared with 52.3 for the registered Ramboillet ewe lambs, and 48.9 pounds for the cross-bred Corriedale-Rambouillet ram lambs as compared with 58.2 pounds for the registered Rambouillet ram lambs. The Corriedale aged ewes sheared an average of 8.47 pounds of wool, while the registered Rambouillet aged ewes sheared an average of 8.99 pounds. The yearling Corriedale ewes sheared 7.3 pounds, while the registered Rambouillet yearling ewes sheared 7.36 pounds. The health and thriftiness of the Corriedales for the year have been somewhat better than usual, but even so the Rambouillets show more hardiness and thriftiness under southwest Texas conditions. The two bands of sheep have been handled identically. The Division of Range Animal Husbandry will report on the complete notes and data taken on the two flocks.

J. M. Jones, W. H. Dameron, B. L. Warwick.

Inheritance of Angora Goats

This work embraces flat and ringlet type fleece in Angora goats. Systematic line breeding and cross-breeding of the two types are necessary. Detailed breeding records include (1) birth weight of kids; (2) weaning weights; (3) weights at 1 yr., 2 yrs., 3 yrs., etc., as long as the goats are in the flock; (4) grease and clean weight of fleece; and (5) quality or fineness of fleece as determined by the diameter measurements of fiber samples taken from the shoulder, side and thigh, once a year for each breeding animal as long as it is retained in the flock. This year 164 registered Angora does which were bred to six registered Angora bucks were used. Results will be found in the report of the Division of Range Animal Husbandry.

J. M. Jones, B. L. Warwick, W. H. Dameron.

Sheep Inheritance Studies

It is important to know the difference in production of lambs and wool from the two predominating types (B. & C.) of Rambouillet sheep as produced in this region of the country. For the work this year 184 head of registered Rambouillet ewes bred to 25 head of registered Rambouillet rams were used. There is a predominance of C-type animals in the Station flock. The ewes are shaped up in the fall prior to the breeding season for mating with designated rams suitable for the study of body type and wool production. The lambs from these matings are studied through data on (1) individual breeding weights of ewes and rams; (2) lambing weights, including birth weight of lambs; (3) weaning weights of lambs; (4) individual fleece weights (both grease and clean) of all breeding animals retained in the breeding flock; (5) score or rating of each individual comprising the flock; (6) evenness and fineness of fleece as determined by samples taken from shoulder, side and thigh once annually; and (7) records of body type and conformation. These records are taken immediately before and after shearing in the spring.

Results will be found in the report of the Division of Range Animal Husbandry.

J. M. Jones, B. L. Warwick, W. H. Dameron, S. P. Davis.

Crutching or Tagging of Bred Rambouillet Ewes

Fleece worms cause considerable trouble in sheep in long wool in this section of the country in the spring of the year, more especially if there is dampness and humidity. In an effort to eliminate this trouble, the advisability of crutching or tagging sheep deserves some study. There is also the factor of submitting for sale wool which is free of tags and sweat locks. Where sheep are lambed loose in pastures, it is also of value to have the wool clipped from around the udders of the ewes to prevent a certain percentage of lambs from starving to death by nursing on the tags and sweat locks. For this work this spring we tagged 189 head of registered Rambouillet aged ewes, by clipping the wool from around the tail-head, down the britch, and around the udder. The amount of tags per ewe averaged .55 pound. From 58 head of registered Rambouillet yearling ewes tagged in the same manner, an average of .45 pounds was clipped. A report of the analysis of data on this work will be made under the Division of Range Animal Husbandry.

W. H. Dameron, J. M. Jones, S. P. Davis.

Shrinkage Tests on Wool and Mohair

During the year this Station collected from the registered sheep 388 fleeces of wool which were sacked individually and marked for identity; similarly it collected eighty fleeces from registered Angora goats. These were sent to the Wool Scouring Plant at College Station for scouring and shrinkage tests. The fleeces from twenty-four aged grade ewes were also sent for shrinkage tests.

Results will be found in the report of the Division of Range Animal Husbandry.

W. H. Dameron, S. P. Davis, J. M. Jones.

Screw Worm and Fly Repellent Study

Screw worm infestation among livestock in the stock raising area of Texas constitutes a major problem of the livestock raising industry. It is estimated that this menace alone is responsible for $8,000,000 to $10,000,000 annual loss. Considerable work has been done by the Federal Government in an effort to control the blowfly and thus reduce the livestock loss but it is generally conceded that there is an enormous amount of investigation to be done yet to accomplish the desired results. Some work has been done at this Station in this connection in cooperation with the Bureau of Entomology, U S. Department of Agriculture. In 1936 the Federal Department built a screened fly house here, 30 ft. long by 20 ft. wide, to study the healing of screw worm infested animals through the fly house as compared to the "wormy trap" method. 1937 was a light screw worm year. Only thirty-three cases were treated through the fly house. These gained weight in the house and healed more rapidly as compared to outside.

W. H. Dameron.

Meal and Salt Feeding for Lambs

A considerable amount of interest has been manifested in feeding sheep various mixtures of cottonseed meal and salt to control poisonous plant troubles and promote growth in young stock. We are called upon frequently for information on the subject and have maintained somewhat of a biased feeling in that there is danger of the animals consuming excess salt to produce objectionable results. Even so requests for information continue to come in, with the result we have conducted several feeding tests. The feed mixtures used have been composed of 100 lbs. cottonseed meal and 10 lbs. each of pulverized oystershell and No. 1 sheep salt fed on the range through self-feeders. From a gain standpoint the response has been favorable for four to six week periods for sheep, but it has failed entirely to prevent bitterweed trouble. The average amount of the feed consumed for the feeding periods ranges from 10 to 16 ounces per head daily. Long feeding tests have not been required because of rain and improved range conditions early in the spring.

W. H. Dameron, O. L. Carpenter.

Deferred Grazing

In an effort to increase the desirable winter growing range plants on the Station, two pastures were taken for study by vacating and deferring the grazing on one and comparing it with one not vacated. Fall precipitation in 1936 was sufficient to provide adequate moisture for plant germination and winter growth in 1936-1937.

In February, 1937, we staked off eight meter square quadrats in the pasture vacated and seven in the pasture that remained stocked. Complete vegetation counts were made and recorded in both pastures at that time and then at about thirty day intervals until June, when the plants had reached maturity.

At the beginning of the test sixteen different varieties of very small plants were identified in the vacated pasture while in the stocked pasture there were seventeen. There was a striking contrast in the two pastures as time went on and the desirable plants attained grazing size. They were all consumed by the livestock in stocked pasture, while in the vacated pasture they reached maturity and produced an excellent seed crop.

At the end of the year a very significant contrast is evident in that one species of plants (plantains) show a 400% increase in the vacated pasture while in the stocked pasture there is a 450% decrease. The contrast in other plants show the same trend but not such wide differences.

The difference in maturity and seed production of bitterweed in the two pastures was 52% for the vacated pasture, while it was 75% in the stocked pasture. No doubt the desirable winter growing plants in the vacated pasture competed enough for moisture and growing conditions to make the difference in per cent of bitterweed maturity in the two pastures.

W. H. Dameron, V. L. Cory.

Range Botany

The vegetation studies of the range in the pastures of the Ranch Experiment Station have been continued by means of quadrat counts. In connection with a test of deferred grazing, a series of permanent quadrats have been located in pastures E and I, and during the growing season estimates of the population of species based largely upon counts in which the plants were not removed were made from time to time.

V. L. Cory.

Veterinary Projects

Toxicity of Bitterweed (Actinea odorata): This project was completed and the results of the investigation published as Experiment Station Bulletin 552, "Toxicity of Bitterweed for Sheep."

I. B. Boughton and W. T. Hardy.

Swellhead of Sheep and Goats: Inactive. The cause, consumption by white-skinned animals of the buds and flowers of the sacahuiste plant *(Nolina texana)* and subsequent exposure to sunlight, has been described in previous reports. The great reduction of the number of these plants on the range has greatly decreased the economic importance of this disease.

I. B. Boughton and W. T. Hardy.

Hard Yellow Livers of Sheep and Cattle: This fatal disease disappeared in 1932 and did not reappear until the summer of the present year when the first field investigations revealed affected sheep on three ranches. Subsequent investigations showed that the disease was prevalent among sheep of all ages on at least seven ranches in the western part of Glasscock

County. All indications are that many sheep and cattle grazing a large scope of country through parts of Glasscock, Reagan, Upton, and probably adjoining counties are affected with the disease.

In the grazing trials, in which healthy sheep were running on ranches where the disease occurred in 1931 and 1932 and which continued for two years (1932-1934), all results were negative.

Feeding trials of the weed, *Aplopappus spinulosus*, suspected of causing this disease were all completely negative. Four healthy sheep consumed 304.5%, 506%, 1081% and 222.9% of their body weights respectively over a period of 19½ months and remained normal. No lesions of the disease were found when the animals were slaughtered and autopsied.

Vegetation surveys, conducted during the late summer and early fall months of the present year brought *Senecio longilobus*, a known poisonous weed, under suspicion. Feeding trials of this weed are under way at the present time.

I. B. Boughton and W. T. Hardy.

Contagious Ecthyma (Soremouth) of Sheep and Goats

Soremouth virus, potent and bacteria-free, did not grow when inoculated, on the 12th day of incubation, into the chorionic layer of twelve fertile chicken eggs. One egg hatched normally, ten eggs showed no growth subsequent to inoculation (embryos dead), and the chorion of one egg in which the embryo died about the 17th day of incubation (five days after inoculation) showed two small blackish-grey spots, the embryo was shrunken and dry and the remaining yolk and egg white were glue-like. This chorion was minced, emulsified in sterile normal saline solution, and rubbed into the scarified skin of the flank of a soremouth susceptible lamb. Five days later a small area of inflammation, about 4 mm. in diameter, appeared at the site of inoculation. This "take" progressed to the pustular stage, dried up and disappeared on the eighth day.

Dried, powdered soremouth scab in a clear-glass, stoppered flask, kept at room temperature in daylight for 61 months, was weakly potent when inoculated into the scarified skin of a soremouth susceptible lamb.

In an attempt to produce pure virus in quantity, .2 cc of potent bacteria-free soremouth virus was injected aseptically into the amniotic cavity of the uterus of a three months pregnant ewe. The animal died three days later; the wound was healing nicely and there was no evidence of peritonitis. No lesions of soremouth were found either on the fetal membranes or in the uterus itself.

I. B. Boughton and W. T. Hardy.

Stomach Worms (Haemonchus contortus) of Sheep and Goats

In continuation of the longevity studies of *H. contortus* larvae on the range all four of the plots, which were fenced and ditched in October, 1934, were found to be free of these larvae after 31 months. In testing these plots, parasite-free, bottle-fed lambs were grazed on the plots for ten days, removed for a 28-30 day period to clean, concrete stalls and then killed and a detailed search for *H. contortus* made in each animal. All four of the animals used in testing these plots were negative for these parasites. Previous tests had shown that two of these plots were carrying infective larvae nine months previous to the tests reported here.

An eight months old parasite-free lamb was drenched with 4200, 4200, 5200, 4200, 5000, and 7200 live third stage of *Haemonchus contortus* larvae respectively on five consecutive days. Twenty-three and thirty-one days later this animal was again drenched with 7300 and 15900 infective *H. contortus* larvae respectively. Fecal examination and culture first showed *H. contortus* eggs on the twenty-second day after the first drenching with larvae. Fecal examinations and cultures were positive for eggs for the next ten consecutive weeks. At this time the animals received, orally, 50500 infective *H. contortus* larvae. Weekly fecal examinations and culture were negative for eggs for the next five months, when the animal was turned into a *H. contortus* infested pasture with infested sheep. Weekly fecal examinations and cultures were negative for 72 days. Nine months later fecal examination showed fewer than 400 *H. contortus* eggs per gram and the animal was in good health. Two months later the animal died from bitterweed poisoning. Five *H. contortus* were found at autopsy.

Three lambs, which had recovered within eight months from artificially induced *H. contortus* infestation and then showed a few eggs in the feces 120 days after being turned into infested pasture, remain in excellent condition at the present time, fifteen months later. During this period the animals have been on the range and occasional fecal examinations have revealed 400 eggs per gram or less.

Six parasite-free lambs, each artificially infested with 660 live infective *H. contortus* by drenching, had virtually recovered after six months during which time they were kept in concrete stalls. Six months later, when two of the animals were showing no eggs in the feces and the remaining four fewer than 200 eggs per gram of feces, they were turned into an infested pasture. At the present time, seven months later, the animals are in excellent condition and monthly egg counts have shown either a very few eggs or none at all. One lamb died of intercurrent disease three months after being turned to pasture.

Three test lambs, free of parasites, were turned into an infested pasture, when one year old. During the succeeding seven months two of these animals have been consistently negative for *H. contortus* eggs (as judged by fecal examinations and cultures) while the third lamb showed a light infestation, less than 400 eggs per gram of feces, four months after being turned to pasture. These animals remain in excellent health, while younger lambs in the same pacture have manifested clinical stomach worm disease.

A five month old test lamb, drenched with 45 mature live female *H. contortus*, showed eggs in feces eleven days after treatment and was positive on weekly fecal examination for the next nine months. Two months later this animal received 18000 infective larvae orally and reached the peak of egg production (16400 eggs per gram of feces) two months later. Thirty days later the egg count had decreased to less than 400 per gram of feces and the animal remains in excellent health at present, thirteen months later, despite the fact that it has been grazing in an infested pasture for the past seven months.

I. B. Boughton and W. T. Hardy.

Serum Calcium and Inorganic Phosphorus of the Blood of Range Sheep on the Edwards Plateau of Texas

Sufficient tests have not been conducted in this project as yet to draw any conclusions. The blood of sheep tested to date has shown no appreciable deviation from the normal range of these minerals.

I. B. Boughton.

Infectious Entero-Toxemia of Young Lambs

Work on this disease, caused by *Clostridium Welchii*, Type D, was confined principally to means of prevention by vaccination and by the use of antitoxin.

Field experiments, in which 473 pregnant ewes were injected with 5 cc. sucutaneously each of the anatoxin, one month previous to parturition, yielded little information, since only a few cases of the disease occurred among the suckling lambs on the three ranches where the ewes were located. A total of twelve lambs (1.47%) died from the disease among 812 lambs dropped by 1,138 control ewes, while five lambs (1.27%) of the total of 392 lambs dropped by the treated ewes succumbed to infectious enterotoxemia.

A potent antitoxin, secured from a horse hyperimmunized by repeated injection of a 96 hour meat mash culture of the causative organism, injected subcutaneously in 8 cc doses into a total of 718 susceptible range lambs on three ranches stopped the outbreaks of the disease abruptly and only one treated lamb died from the disease. Losses in control pastures continued for approximately two weeks subsequent to the injection of the test lambs.

Experiments with an alum precipitated toxoid and with the anaculture of the causative organism showed that two subcutaneous injections into sheep, at three weeks intervals, did not induce sufficient lasting immunity.

A single subcutaneous injection of sheep with 2 cc each of a zinc chloride precipitated toxoid of the causative organism, showed that demonstrable immunity by toxin-antitoxin tests resulted and lasted for approximately ten weeks. A second similar injection at this time increased the immunity and at the present time, seventy days later, the animals are still carrying antitoxin in their blood streams.

Field experiments, in which 2,000 pregnant ewes were vaccinated twice (at three weeks intervals), with the last vaccination given approximately one month prior to parturition, have been inaugurated, using a 2 cc subcutaneous dose of the zinc chloride precipitated toxoid of the organism. This method of indirect passive immunization of the suckling lamb is being tried, since it is impractical, under range conditions, to attempt to vaccinate the lamb itself.

The disease, caused by *Cl. Welchii*, Type A, was demonstrated in a herd of Hereford range calves from ten days to two months old. The causative organism was isolated from the small intestines of two typically affected animals and a Type A toxin was demonstrated in the sterile filtrate made from the small intestinal contents of these calves. Symptoms among these animals were similar to but of longer duration than those observed in the Type D intoxication among lambs. The mortality was very high, since twenty-two calves, exactly half the animals in the herd, died within a period of approximately four weeks. This outbreak, which occurred before any potent antitoxin was available, was stopped by changing the animals to a rough, dry, hilly pasture.

I. B. Boughton and W. T. Hardy.

Bone Meal and Salt Feeding Experiments

Determinations of the serum calcium and inorganic phosphorus in the blood of cattle running on the range and licking, free choice, a 50-50 mixture of bone meal and plain salt (CaNl), made at six months intervals during the year, showed no appreciable variation in amounts from similar blood determinations made at the same times upon a comparable number of cattle running in a comparable pasture and licking plain salt (NaCl) free choice. The bone meal group produced a larger percentage of calves all of which were heavier than the calves from the control group. This was the third and final year of this experiment.

Similar results in regard to the serum calcium and inorganic phosphorus blood determinations were found in monthly tests of a group of four cows, two of them being fed measured amounts of a 50-50 mixture of bone meal and salt three times weekly and the other two animals receiving measured amounts of plain salt at the same periods. All of these animals were running in the same pasture and all four of them produced healthy calves which showed no appreciable variation in weight. This is the third year of this experiment.

Miscellaneous Feeding Trials of Suspected Plants

One nine months old lamb consumed 9633 grams (32.46% body weight) of the green and ripe seeds of *Colubrina texensis* at rate of 1/16 of 1%

body weight daily for 119 days, 1/8 of 1% body weight daily for 128 days, and 1/4 of 1% body weight daily for 33 days. The animal remained healthy throughout the trial.

Another nine months old lamb consumed 7227 grams (27.5% body weight) of green and ripe seeds of *C. texensis* in 170 separate feedings during 292 consecutive days and remained healthy.

The seed of this plant came under suspicion as playing a part in the causation of an obscure condition occurring annually among sheep on several ranches in the extreme western part of Val Verde county.

I. B. Boughton and W. T. Hardy.

Laboratory Specimens

Diagnostic and experimental specimens to the number of 703 were handled during the period under review.

Insects Affecting Animals

(In cooperation with Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.)

Goat Lice: County Agents in Texas have launched a campaign for the control of goat lice. As a result of this work the elemental sulphur dipping idea is spreading rapidly among the ranchmen.

The benefits of elemental sulphur dipping is shown by the fact that not only are the goats rid of the ectoparasites, but a healthier animal results. The reaction is shown by an increase of approximately one quarter of a pound of mohair, or more per animal, over a five to six month period.

Experience has also shown that:

A. Goats should be treated before dipping, when found heavily infested with stomach worms.
B. Goats should be handled with care while being dipped.
C. Special attention should be given to wetting the head.
D. Goats should be dipped twice at eleven day intervals.
E. Goats should be dipped into clean pasture and former pasture should be ridden for strays and undipped goats.

Tests show that the colloidal sulphurs, 5000 mesh and bentonite sulphurs, appear not to kill any faster than the so-called 325 mesh sulphur.

Bentonite sulphur, although toxic, will dry out and mat wool and mohair fibers, a very undesirable feature. The life of the fiber is gone, even though strength is retained.

Wetting Agents: The Cardinol soaps, a recent development, have added a new and valuable asset to the wetting of elemental sulphurs. Hundreds of tests have been made. Most of the combinations are undesirable in alkaline water. Many more combinations will tolerate soft water. In all the Western States, hard water such as well, stream, and creek, is fairly common. To be successful a dip must tolerate alkali water.

Approximately 62 combinations have been developed that will wet elemental sulphur in the more common alkaline water, namely, lime water, sodium and magnesium sulphate water.

Sheep Fly: This wingless fly (improperly called sheep tick) is becoming widely spread through the sheep and goat producing sections of West Texas. The fly is adapting itself to West Texas and is known to have been present on several ranches from 15 to 25 years. It is carried over the hot season in a very inactive condition. It develops very slowly during the fall and winter months. From midwinter on through the spring months, the fly develops quite rapidly, and considerable damage is done. Not only does this parasite suck blood, but it stains the animal fiber, a very undesirable result.

Circumstantial evidence is at hand to show that the pupae (so-called eggs) of the sheep fly may require from 16 to 48 days for emergence. The adults are easily killed with wettable sulphur, but the pupae are not. The intervals between dipping are yet to be determined.

Oestrus Ovis or Nose Fly of Sheep and Goats: The extremely dry, hot summer and the opposite weather conditions, in October, November, and December were very unfavorable for the activity and the emergence of the sheep fly.

Only a small number of adult flies were collected. The following percentages were noted:

Female ♀ flies having undeveloped eggs	8%
Female ♀ flies having eggs	34%
Female ♀ flies having larvae	9%
Male ♂ flies	23%
Female ♀ flies not examined	26%
	100%

Effect of First Instar Larvae on Eye of Sheep: Larvae were introduced in the eyes of sheep and goats, both upon the eyeball direct and upon the nictitating membrane. In only one instance did the larvae "take." The eye, or rather, tissues and skin surrounding the eye became swollen and red, due to the irritation. This lasted a little over 24 hours when the swelling rapidly went down with apparently no injurious effect on the animal.

Miscellaneous:

Winter Tick (Dermacentor albipictus, Pack.)
Powdered Devil's Shoe String, containing rotenon, when applied as a powder, over the entire surface of a horse and worked into the skin, gave almost complete control of the activities except for a few engorged ticks.

Engorged female ticks, if left in the pure powder may never deposit eggs, even though the engorged adult ticks are not killed.

Larvaecides:

Several chemicals were tested. Most of them were discarded for one reason or another, but the promising ones, that need further study are amylene dichloride, ethylene-dichloride, acrolin, mesitil oxide, benzol, aniline oil, xylol, ether, and di-nitro-artho-hexyl-phenol.

O. G. Babcock, Bu. Entom. and Pl. Quar.

SUBSTATION NO. 15, WESLACO

Substation No. 15 is located in the Lower Rio Grande Valley, Weslaco being the designated postoffice of the station. The farm consists of 100 acres of improved land, lying about midway between the cities of Weslaco and Mercedes, on the main Valley highway. The four counties forming the southernmost part of the state are served by the Valley Station.

Citrus fruit production is probably the most important industry in the irrigated portions of this region, but vegetables, cotton, and feed crops are important sources of income on many Valley farms. The development of the canning and processing industries in this region has increased the demand for crops which were relatively unimportant a few years ago, and there has been increased demand for information pertaining to these cannery crops. Studies relating to the control of insect pests and diseases are fully as important as the introduction and development of new varieties and cultural investigations with the various crops.

Citrus Fruit Experiments

Grapefruit Production Investigations: Trees in the seventeen year old Marsh grapefruit grove are in much better condition than at any time since the unfavorable season of 1933. Some of the trees on the areas underlain with hard pan are in very poor condition, but many of the trees, on the better plots, produced normal yields of fruit this season.

A fertilizer test was started on one block of fairly uniform trees in this old orchard that were formerly used in insect control investigations. Nitrogen from three sources, and organic- and inorganic-base complete fertilizers are being compared.

A pruning test in which the tops of alternate rows of trees were opened up to admit sunlight was started this season, in an effort to determine the effect of this practice on interior fruiting. In connection with the pruning work, a study of the efficiency of a number of pruning wound protectant paints is being conducted.

W. H. Friend.

Citrus Variety Adaptability Studies: Hamlin, Joppa, and Texas Navel are the outstanding orange varieties in this test, while Ruby, Pink Marsh,

Marsh, and Little River Seedless are the most desirable varieties of grapefruit. Production from twelve year old Hamlin orange trees slightly exceeded seven hundred pounds per tree, compared with approximately nine hundred pounds for the better trees of Pink Marsh grapefruit. Trees of the early Algerian tangerine produced fair yields of fruit this season, but nothing to compare with yields from the better varieties of oranges and grapefruit. Meyer lemon trees produced yields comparable with those of grapefruit trees of the same size. Among the more valuable new varieties which fruited for the first time this season were: the Mineola tangelo, the Perrine lemon, Glen citrangedin, and the Lou Seedless, and the Rico orange.

W. H. Friend.

Citrus Root Stock Adaptability Test: In the older planting, trees on Rough lemon and Cleopatra mandarin stock have been more productive, but there has been higher tree mortality from root diseases, and the fruit has a decided tendency to be larger and coarser than that produced on sour orange understock. Fruit from trees budded on Rusk citrange is smoother and heavier than that produced on sour orange root stock, but the trees are much less productive.

In the nursery tests, seedlings and budlings of Brazilian sour, Paraguay sour, African sour, and Standard sour oranges made excellent growth. Seedings of several sweet orange varieties—Oroville, Weldon, Raymondville, Texas Navel, and Hamlin—made excellent growth, but budlings on these stocks showed marked chlorosis and failed to develop into satisfactory trees.

W. H. Friend.

Citrus Fertilizer Tests: On the old fertilizer blocks that were abandoned in 1935 after eight annual applications of fertilizer materials, it is interesting to note that tree condition and fruit production was definitely better on the plots which received bone meal, sulphur, or manure.

Results of a five-year test in a 14-year-old commercial grapefruit grove show that ten pounds per tree of sulphate of ammonia, along with bulky organic matter, has given significant increases in yield above those secured with five pounds per tree of this same material or ten pounds per tree of 10-30-10 or 10-30-0 fertilizer. Neither the exterior appearance or the interior quality of the fruit was improved by the use of complete fertilizer.

A one year test with seven-year-old Marsh trees showed that the fertilizer treatments had little or no effect on yield. Ammonium phosphate (16-20-0) produced slightly higher yields than a comparable amount of ammonium sulphate, or equivalent amounts of nitrogen, obtained from either an organic base or inorganic, complete fertilizer. Unfertilized plats, which were mulched with sorgo hay that was later disked into the soil, produced the highest yields of fruit.

W. H. Friend.

Progeny Studies with Citrus: In one block of five lots of progeny trees of the Pink Marsh grapefruit, two groups were consistently more productive than the other lots, but these are not progenies of the two superior parent trees. There was no significant difference in the yields secured from four lots of progenies; two of which were from exceptionally high producing parent trees, while the others were from two relatively low producing parent trees.

W. H. Friend.

Reclamation Studies: The concentration of soluble salts in the root zone and the adverse effects of these salts on plant nutrition are the most important causes of early decline of citrus trees in this region. Liberal fertilization with both organic and inorganic materials, the use of sulphur, and minor elements are all helpful in restoring decadent, salt-injured citrus trees to a more normal state of health. The reclamation of trees planted on shallow soil with an impervious subsoil presents a very difficult problem.

W. H. Friend.

Cold Storage Experiments with Citrus Fruits: Twenty-four lots of Valencia oranges and fourteen lots of grapefruit were placed in cold storage near the close of the 1936-37 season, while seven lots of Valencia oranges and five lots of grapefruit were held in common storage. Fruit stored at 45° F. showed much less loss from pitting than that stored at 34° F., and there was no appreciable difference in losses from decay in the two lots of fruit. Foil and cellophane wrappers and air-excluding crate liners were very effective in reducing losses from cold storage spotting (pitting) and decay. Fruit with a narrow sugar to acid ratio held up in storage much better than the milder flavored fruit of the Marsh variety. Valencia oranges were held in cold storage at 45° F., for ninety days with only negligible losses. Grapefruit was successfully stored at 45° F. for six weeks but was a total loss at the close of the twelve weeks period. Fungicidal washes reduced losses from blue mold.

In the comman storage tests, there were excessive losses due to drying and decay at the end of a four weeks period, except in the case of the foil and cellophane wrapped fruit and in the lots of oranges stored in "lined" containers.

W. H. Friend, J. F. Wood, G. H. Godfrey.

Wrapping Tests with Citrus Fruits: Foil, cellophane and waxed wrappers and waxing were all highly effective in reducing losses in thin skinned varieties of citrus, such as Meyer lemon, both in common and cold storage. Cellophane and waxed containers were also effective in reducing losses due to shrinkage, and when used with proper quantities of iodine, were quite effective in preventing decay.

W. H. Friend.

Citrus Crosses: A large number of crosses between different varieties and kinds of citrus were made. The following crosses were successful: Thornton tangelo crossed with Ruby grapefruit, Thornton tangelo crossed with Valencia orange, Temple orange crossed with Valencia orange, Thornton tangelo selfed, Texas Navel crossed with Meyer lemon, Valencia orange crossed with Meyer lemon, and Temple orange selfed. Seedlings growing from crosses of previous seasons are: Ruby orange x Meyer lemon, Thornton tangelo x Clementine tangerine, Thornton tangelo x Pink Marsh grapefruit, Pineapple orange x Pink Marsh grapefruit and Valencia orange selfed.

J. F. Wood.

Orchard Heating: The size of the area in the orchard heating test at Engelman Gardens was increased to approximately 350 acres. The heaters were placed in the orchard and filled with oil ready for firing. Eighteen thermometer stands were erected in advantageous locations throughout the orchards.

An electrically powered propeller, known as a Wind-jammer, was installed on a tract of 40 acres of citrus for frost protection. It was intended that thermometer readings be taken in this tract as well as in the heated area.

Weather conditions did not necessitate firing the heaters or running the Wind-jammer; hence the test was not conducted this season.

J. F. Wood.

Citrus Wood Decay Investigations: This project was initiated during the fall of 1937. Several proprietary wood preservatives were applied to citrus wounds. Readings were taken as to the effectiveness in preventing fungus growth and as to the effect on cambial activity. Solutions of growth promoting plant hormones were also used. Although some of the preparations show promise for citrus wound treatment, no definite conclusions are justified at this time.

J. F. Wood, G. H. Godfrey.

Vegetable Crops Experiments

Cabbage Variety Trials: No extensive tests were conducted this season, but it now appears that Copenhagen Market, Midseason Market, Round Dutch, and Danish Ballhead about fill the needs of Valley growers for early, intermediate, and late varieties of cabbage. Superior, better adapted strains of these standard types should be developed.

W. H. Friend.

Adaptability Tests with Sweet Corn Varieties: The development of the canning and quick freezing industries in the Lower Valley has renewed interest in sweet corn varieties. Only the most ear worm-resistant varieties will produce under Valley conditions, but some of the newly developed strains are quite promising. Crossed seed (Mossheart Sugar x Purdue) produced good yields of medium to large sized ears of exceptionally good quality. Tuxpan Sugar produced good yields of worm-free ears, but matured much later than other varieties.

W. H. Friend.

Pea Variety Tests: Twenty-six varieties of peas were included in the spring trials with this crop. Late varieties failed to mature seed during the fall season, but it was thought that they might prove to be more productive during the longer days of the spring season. This proved to be true, but it was found that the insect, disease, and bird hazards, and probably the frost hazard, are more serious in the spring. Among the more promising varieties were: Resistant Alaska, Early Sweet, and Early Harvest in the early class; Thomas Laxton, Gradus, Ace, and Early Kay in the second early class; and Asgrow Teton and World Beater in the mid-season class. Resistant Perfection, and Canner King were the most promising late varieties.

Potato Seed Stock Tests: The results of these tests show how little potato seed certification really means, without a uniform national law regulating this business. Yields from selected seed stocks furnished for official test were exceptionally fine, while the yield from a commercial lot of certified seed from one of the same growers was very low. Some commercial fields showed as much as 25% of serious degeneration diseases, such as "curly dwarf," "haywire," and "black leg." It is obvious that more adequate seed certification laws are needed to protect the commercial growers of early potatoes in Texas.

Green Manuring Tests with Potatoes: Plots of land which grew cowpeas as a summer crop for three seasons produced 119.7 bushels of marketable potatoes per acre, compared with 76.9 bushels for the plots that grew cash crops (cotton or corn) during the three previous seasons.

Fertilizer Tests with Potatoes: The widespread occurrence of degeneration disease in the plants on these plots made it impossible to arrive at an accurate measure of the effect of the treatments on yield.

Adaptability Test with Minor Vegetable Crops: Of the squash varieties tested, Golden Delicious, Kitchenette, and Banana deserve special mention because of their yielding capacity, culinary quality, and keeping quality. Orange Winter Luxury pumpkin produced excellent yields of small (8-10 inch) pumpkins of fine quality.

Cantaloupe and cucumber plantings were completely ruined by insect depredations and disease.

Plantings of Red kidney, Navy, and Pinto beans failed because of mosaic disease. Dusting experiments to control insect vectors will be conducted next season.

Plantings of beans, beets, broccoli, carrots, collards, kale, lettuce, peas, potatoes, mustard, spinach, turnips, and tendergreen made excellent yields this season. The use of leguminous green manure crops in the rotation did not materially increase yields, except in the case of beans, peas, and potatoes. Plantings of Chinese cabbage failed because of foliage disease (macrosporium leaf spot).

Fall plantings of broccoli, cabbage, egg plant, peppers, squash, and tomatoes were delayed by the unfavorable, dry weather but produced very satisfactory yields. The control of insect pests was the most important problem connected with the growing of these crops.

W. H. Friend.

Tomato Variety Tests: Stockdale and Clark's Early tomatoes gave the highest total yields of marketable fruit, and also produced high percentages of early fruit. Two new varieties, Early Shipper and California Dawn, yielded exceptionally well this season. Earliana and June Pink produced the highest yields of early fruit but ranked low in total yield of marketable fruit, because of the irregular shape of the fruits. Grothen's Globe and Rutgers, two rather popular varieties, failed to make a creditable showing in these tests conducted on sandy loam soil. These varieties matured their fruit relatively late, and the percentage of severely puffed (hollow) fruit was quite high. Paired row plantings gave superior yields in the case of practically all varieties but delayed maturity to a slight extent. Pruning of heavy vined varieties will help to overcome this difficulty.

W. H. Friend.

Tomato Crosses: Several crosses were made involving Marglobe, Break O'Day, Rutgers, Scarlet Dawn, Grothen Globe, and Stokesdale varieties. None of these crosses were successful. Dry hot weather materially interfered with the normal set of tomatoes at the time the crosses were made.

Fifteen plant selections were made from the F_3 generation planting. These selections were as follows: Cooper's Special x June x Pink, 3 plants; Cooper's Special x Gulf State Market, 2 plants; Cooper's Special x Marglobe, 4 plants; Bonny Best x Cooper's Special, 4 plants; and Marglobe x Pritchard, 2 plants. One of the Cooper's Special Marglobe selections is very promising. The vine is of medium size, semi-erect, with dense foliage. The fruit is large, globe-shaped and dark red. One of the Bonny Best-Cooper's Special selections, which shows promise, has a large dense, spreading vine with very large, red, globe-shaped fruit.

J. F. Wood.

Adaptability of Vegetable Varieties for Canning and Quick Freezing: This is a cooperative project with the U. S. Department of Agriculture, Citrus Products Laboratory. Twenty-five varieties of English peas, and eight varieties of snap beans were grown. Detailed measurements were made on the plants and pods. The peas and beans were packed both dry and in brine and processed by canning and quick-freezing.

Bird damage and mildew were the limiting factors in the pea trials. The entire first crop on the early varieties was lost from bird damage. The late maturing varieties became so severely infected with mildew that no yields were obtained. Notes were taken on the following thirteen varieties: President Wilson, Gradus Improved, Laxton's Progress, World's Record, Thomas Laxton, Hundredfold, Asgrow Teton, Extra Early Gradus, Long

Pod World's Record, Dark Podded Thomas Laxton, Asgrow Canner King, Duplex, and Asgrow Glacier. The following twelve varieties were grown but no notes were obtained: Alaska, Asgrow Pride, Asgrow Triumph, Perfection, Green Admiral, Asgrow Major, Dwarf Alderman, Prince of Wales, Strategem, Asgrow No. 40, Alderman, and Onward. The Thomas Laxton variety is the most popular one so far with the commercial quick-freezing concerns in this section.

The bean varieties tested were: Bountiful, Asgrow Stringless Greenpod, Burpee's Stringless Greenpod, Full Measure, Giant Stringless Greenpod, Keeney's Stringless Greenpod, Idaho Mosaic Resistant Refugee, and Wisconsin Mosaic Resistant Refugee. The highest yield was obtained from Keeney's Stringless Greenpod (108.5 bu. per acre), and Bountiful second with 102 bushels per acre. All of the other varieties produced less than 80 bushels per acre.

J. F. Wood.

Agronomic Experiments

Cotton Variety Test: Stoneville No. 4A was the outstanding variety in the 1937 tests with a yield of 2.22 bales per acre and a lint length of 1 3/32 inches. Delfos 531 A, Delfos 719, Misdel No. 4, Misdel No. 7, D. P. L. No. 11, and Mebane produced yields that were quite comparable with one another (1.75 to 1.80 bales per acre). Mebane produced the shortest staple (1 1/16 inches), compared with 1 1/8 for Misdel No. 6. Boll size was smallest in D. P. L. and Misdel No. 4, intermediate in the case of Delfos 719 and Misdel No. 7, and largest in the case of Stoneville 4A and Mebane.

Cotton Fertilizer Test: The residual effects of fertilizer materials, applied to a winter crop of cabbage, produced the highest yields of cotton, on the plots that received cyanamid and sulphate of ammonia at the rate of 400 pounds per acre and least in the case of those receiving nitrate of soda. Plats which had received 600 pounds per acre of 6-18-0 or 0-18-0 fertilizers produced yields only slightly below those from plats that received the heavy applications of nitrogen but only 12½% higher than those from unfertilized plats.

Cotton Irrigation-Spacing Test: The drouthy summer season of 1937 made conditions ideal for conducting an irrigation test with cotton. Two spacings (12 and 16 inches) were used and irrigation water was applied on all plots prior to planting and on two lots of plots during the growing season. A single application of water during the boll forming period increased the yield of lint cotton 25 per cent in the case of the closely spaced cotton but had little or no effect on the cotton which was spaced sixteen inches apart in the rows.

One lot of irrigated cotton in this test, which received an extra heavy application of nitrate of soda (300 lbs. per acre), developed excessively large stalks, and yields were 20 per cent under those from comparable lots of cotton that received only 100 lbs. per acre of nitrate of soda at planting time.

Corn Variety Test: Yellow Tuxpan produced the highest yield of corn this season, 77.5 bushels, compared with 62.1 bu. for Tuxpan and 55.6 bu. for Tampico.

Adaptability Tests with Legumes: Soy beans appear to respond best to the short day periods of early spring or fall. Excellent sets of pods were secured on practically all varieties in the March and October plantings, but no pods were produced on any of the plantings made during May. Mammoth Brown produced the highest yield of pods with Virginia and Mammoth Yellow ranking next in order. Biloxi and Pee Dee failed to set any pods in either of the spring plantings but set heavy crops during the fall season.

Sesbania and Brabbam cowpeas produced the highest yield of air dried material for green manuring (7.0 and 5.9 tons per acre, respectively).

Miscellaneous Experiments

Date Palms

(In cooperation with the Bureau of Plant Industry, U S. Department of Agriculture)

Variety Adaptability Studies: There are 196 established palms of twenty-five varieties on the Station. Of this number, seventy-six are from Iraq, two from Arizona, and the remainder from California.

The following varieties are represented in the Station collection: Maktoon, Halawy, Thoory, Zahidi, Saidy, Safraia, Dubaini, Hayany, Deglet Noor, Tazizoot, Okhat Fteemy, Khadrawy, Sukkar Nabat, Kustawy, Tadala, Amir Haj, Khatuni, Jaffary, Bedraya, Khasab, Sayer, Ashrasi, Bahrab, Dayri, and Braim.

J. F. Wood.

Propagation of Date Palms: Twenty offshoots were removed and set in the permanent garden on the Station, and nine offshoots were given to cooperators for further testing in the Lower Rio Grande Valley.

Forty-seven fruit bunches were borne on eighteen palms of the following seven varieties in 1937; Halawy, Tazizoot, Sukkar Nabat, Tadala, Khasab, Bedraya, and Khadrawy. None of the fruit cured properly on the palms.

J. F. Wood.

Strawberry Adaptability Test: An adaptability test of eight varieties of strawberries, developed by the Station at Winter Haven, Texas, was started in the fall of 1937. Carolina Missionary and Klondike were used as checks and guard rows. The plants were set in October and started bearing in December.

J. F. Wood.

Adaptability Studies with Ornamentals: A number of ornamental plants were added to the Station collection this season, including a group of native plants. Among the more promising exotics for this region are: *Monstera deliciosa, Pothos aureus, Bauhinia species,* Jacaranda, Feijoa, *Samanea saman,* Bignonia species, *Allamanda Hendersoni, Thevetia nereifolia.* Natives of outstanding merit are *Cordia Boisseri, Citharexylum Berlandieri, Salvia ballotaeflora, Manzanita,* Senisa, ebony, tepehuaje, Rio Grande ash, Brasil, como, chapote and anaqua.

Entomological Experiments

Citrus Mite Control: Finely ground sulphur dust applied to citrus trees either when the trees are wet with dew or when they were dry gave excellent control of citrus rust mites. Wettable sulphur applied to the trees as a dust was less effective for mite control than sulphur dusts.

Pea Aphid Control: Nicobacco (3% nicotine) and sulphur dust mixed at the rate of 80-20 was more effective for the control of this aphid than were pyrethrum or derris combinations.

Tomato Fruit Worm Control: Calcium arsenate-sulphur mixtures as low as 25 parts of calcium arsenate to 75 parts of sulphur applied at the time the plants first came into bloom were effective in increasing the amount of worm-free fruit at harvest.

Scale on Citrus: Utilizing newly determined taxonomic differences between *Aonidiella arrantii* and *A. citrinus,* determinations show that both species are present in this section. Infestations are about equally divided in locations where these scales are damaging.

Fumigation with hydrocyanic acid gas continues to give exceptional results from the standpoint of scale control. Over 50,000 trees were fumigated commercially this season. Costs of this method of scale control compare very favorably with the costs of oil spraying for scale control.

Cottony Cushion Scale Control: Vedalia beetles were reared for distribution to interested parties throughout the state for control of cottony cushion scale. Difficulty was experienced in maintaining adequate food supplies for the beetles.

Records: Records of 384 collections of coccids were added to the Station files from the Ferris collection of Texas Coccidae.

For other Insect Investigations see report of Division of Entomology.

Plant Disease Experiments

Control of Citrus Diseases

Citrus gummosis and wood rot: A serious citrus tree decline, manifest first of all by profuse gumming, then by gradual defoliation and ultimate death of branches and entire trees, has resulted, in part at least, from the effects of the hurricane in 1933 and the freeze in 1935. Most of the gumming is traceable to a rapid spreading internal wood decay caused by a fungus the identity of which has not been determined. Histological studies have shown the fungus to be inter- and intra-cellular not only in discolored tissues but to a depth of at least one-half inch beyond the discolored zones. Work is being undertaken to test a large number of standard and trade chemicals to determine their effects on the tree as well as their fungicidal efficiency. Substantial progress has been made on the development of a filler for cavities in the wood left after the excavation of diseased wood.

Chlorosis: Citrus chlorosis, a condition due to a variety of completely different causes, chief of which is probably the tying up in the soil of iron or zinc necessary for normal metabolism, has been studied in previous years and attempts made to correct it by the application of sulphur or sulphuric acid to the soil. Results obtained thus far indicate that these applications are of benefit to the trees. Further detailed studies along these lines are projected for the immediate future. In connection with the projects studied some method of evaluating the results of the treatments will be worked out.

J. J. Taubenhaus, G. H. Godfrey.

Fruit rots: Stem end rot and the rots due to various blue and green molds have been reduced in experimental lots of fruit by treatment prior to packing with borax, sodium metaborate, and "Wyandotte" soap washes. In connection with the study of storage rots a species of Fusarium has been isolated from the fruits which has been found to occur on the tree also.

Fruit blemishes: Fruit blemishes of various kinds have been observed in the field and have been brought into the laboratory to be diagnosed. Many of these have been found to be due to the spores of the fungi fruiting on dead twigs on the tree, being washed down on the fruits where they germinate and grow into the tissues. Because they rarely sporulate on the fruit, it is difficult to determine the identity of the causal organism.

In field treatments designed to control citrus rust mite, it was noted that sulphur dusting appeared materially to check the amount of the blemish known as "black pit."

A condition known as "sooty blotch" caused by an epiphytic fungus was common on both grapefruit and orange in the spring of 1937. This condition has been removed satisfactorily in the ordinary washing process but not in the dry brushing process.

Winter and Spring Vegetable Diseases

Dill leaf and stem blight: A new disease reported in the Lower Valley has caused widespread damage to dill during the past season. This occurrence is the second report of the disease in America. It appears to be definitely seed-borne and spreads rapidly in wet weather. The affected plants are unmarketable.

Carrot leaf blight: Carrot leaf blight caused by *Macrosporium carotae* has been found to be more severe in the Lower Rio Grande Valley than it is ordinarily considered to be elsewhere in the United States. In cool, moist weather it spreads rapidly, reducing entire fields in a matter of two or three days from high income-producing grade green vegetables to the bag carrot class. Preliminary field tests indicate that (1) copper lime dusts are not sufficiently adhesive to dry foliage to be effective in control, but that when applied to moist foliage, the results are promising; (2) the foliage is tolerant to high copper sprays without injury; (3) high copper low lime Bordeaux sprays may bring about remarkable increases in yield; (4) high copper spray has an actual eradicant effect on the fungus, killing it in the fallen leaves and thus reducing sources of infection for new leaves as the plant continues to grow during the moist weather.

Papaya leaf blight: This disease caused by *Pucciniopsis caricae* results in the yellowing and defoliation of papaya plants. It has been controlled by Bordeaux sprays.

Diseases of Field Crops

Cotton root rot: A detailed study was made of the cotton root rot reports from 1927 to 1936 from which a report was prepared of the results of economic value for use in a cooperative publication to be prepared at College Station.

Cotton seedling diseases: Cotton seed treatment studies of various fungicidal dusts showed significant increases in stand of cotton through the use of ethyl mercury chloride and ethyl mercury phosphate. Increases in stand were also obtained by the use of red copper oxide and copper carbonate. It is recognized that increase in stand alone is of no particular value in field practice, unless the benefit is utilized by reducing the rate of planting.

Diseases of Ornamentals

Dutch Iris: In a test at McAllen, Texas, drenching of the soil with mercuric chloride 1:1000 along the rows of Iris checked the spread of the organism, *Sclerotium rolfsii*, which causes a bulb rot of economic importance.

Aster mildew: Bordeaux sprays and copper lime dusts effectively protected newly developing flower stalks of aster so that the foliage was free of the downy mildew caused by *Basidiophora entospora.*

Sweet pea mildew: Sulphur dust applied at irregular intervals, as needed, to sweet peas prolonged the flowering period.

Root-knot nematode control

Nematodes have been satisfactorily controlled in seed-bed areas by chloropicrin fumigation of the soil. For this purpose the use of the specially prepared glue-coated gas-impervious paper is essential for confining the gas in the soil. An isolated bed of heavily inoculated soil has been in use during the year for testing the resistance or susceptibility of plants to nematodes. The winter legume Fenugreek *(Trigonella foenum-graecum)*, which has been widely distributed commercially during the last few years, has been found to be susceptible.

Nut-grass control with chloropicrin: Incidental to applications for soil sterilization, the value of chloropicrin for the control of nut-grass has been demonstrated at the Lower Rio Grande Valley Experiment Station. Following the insertion of the chemical at the rate of 2½ cc. per injection into holes twelve inches apart and covering tightly with glue-coated gas-proof paper, there was only a fraction of one per cent survival of nut-grass plants. These survivors, all twenty inches or more deep, were readily killed by inserting a few drops of chloropicrin at the base of each and wetting the top of the soil. For eradicating this troublesome weed pest from garden and flower-bed areas, and even for checking encroachment into large fields, this treatment would appear to be completely practicable. It must be kept in mind, however, that valuable plants in the area to be treated will also be killed, so they must either be removed temporarily before treatment, or complete replanting must be done.

G. H. Godfrey.

SUBSTATION NO. 16, IOWA PARK, TEXAS

Texas Substation No. 16 is located in the Wichita Irrigated Valley, two and one-half miles southeast of Iowa Park, and 10 miles west of Wichita Falls, Wichita County, adjacent to the Fort Worth and Denver City railway, and the paved U. S. Interstate Highways Nos. 370 and 70 and State Highway No. 5 from Wichita Falls to Amarillo. The latitude is 33 degrees and 55 minutes north, the longitude 98 degrees and 39 minutes west, and elevation is 974 feet above sea level.

The average annual rainfall at this Substation is 29.86 inches for the 12-year period 1926-1937 inclusive.

The Station comprises approximately 161.79 acres, 90 acres of which are devoted to crops under the irrigation ditch, and the remaining area is in river bottom and creek bottom pastures and waste land. The soil types on the Station are of the Miller and Yahola series and are fairly typical of the soils in the irrigated Wichita Valley. The Station was established in the fall of 1924 for the purpose of conducting agricultural research and experimental work with all crops grown in the Wichita Valley Irrigation project. Irrigation water is furnished the Station from Lake Kemp and Diversion Lake, through the canals of the Wichita County Water Improvement District No. 2. A free and perpetual water right was given the Station by the Irrigation District at the time the Station was established. The work at this Station is directly concerned with the general improvement of agricultural crops and farming conditions in the Valley, and particularly stresses such phases of the work as vegetable growing; fruit production; alfalfa, cotton, small grains, and grain sorghum production; crop rotation; the study of proper uses and amounts of irrigation water required for cotton and grain sorghums; as well as studies in root rot diseases of cotton and alfalfa.

Cotton

Variety Tests: Of eighteen varieties and strains of cotton this year in yields, Acala (Rogers) ranked first with 409 pounds of lint per acre; Half and Half second, with 393 pounds; Deltapine Reg. No. 403 third, with 368 pounds of lint per acre; Acala N 28-5 fourth, with 364 pounds of lint per acre. Other yields were as follows: Lonestar (Gorham), 363 pounds; Mebane 141, 355 pounds; Qualla, 353 pounds; Stoneville No. 5, 352 pounds; Wilds Semi-Wilt Resistant Strain No. 2, 352 pounds; Newboykin, 346 pounds. Of the eighteen varieties tested this year Misdel No. 1-0539 made the lowest yield of all, only 248 pounds of lint per acre.

In earliness Stoneville No. 5 ranked first with 65 per cent of the crop harvested in 131 days from planting date; Half and Half second, with 63 per cent; Deltapine Reg. No. 32 third, with 59 per cent; Ferguson 406 and Misdel No. 1-0539 fourth, with 58 per cent. The latest maturing varieties were Lonestar (Gorham) and Mebane (A. D.) with 32 per cent, Kasch (Ed.) with 36 per cent and Wilds Semi-Wilt Resistant Strain No. 2 and Hurley Special with 41 per cent for the 131 days from planting.

In lint percentanges, Half and Half ranked highest with 42.0 per cent. Other varieties with high lint percentages were as follows: Mebane (A. D.), 38.9; Qualla, 38.5; Kasch (Ed), 37.8. Varieties with low lint percentages were Wilds Semi-Wilt Resistant Strain No. 2, 28; Delfos 531 A, 30.8; Misdel No. 1-0539, 31.1; and Stoneville No. 5, 32.7.

In length of lint, Wilds Semi-Wilt Resistant had the longest staple, 1 1/8 inches. Delfos No. 531 A produced staple of 1 3/32 inches; Deltapine Reg. No. 32 and Acala (Rogers) 1 1/16 inch; and Acala No. 28-5 and Stoneville No. 5, 1 1/32 inches. Varieties producing staple of 15/16 to 31/32 were Lonestar (Gorham), Startex No. 619, Hurley Special, Newboykin, Qualla, Watson, Ferguson No. 406, Mebane (A. D.), Kasch (Ed.), and Misdel No. 1-0539. Varieties below 15/16 were Half and Half, with 7/8 inch staple and Mebane No. 141 with 29/32 inch staple.

In comparable yields for those varieties which have been included in the test for three years or more, Half and Half ranked first with an average of 404 pounds of lint per acre. Ferguson No. 406 ranked second with 384 pounds of lint, followed by Watson and Qualla with 369 pounds of lint per acre. Other yields were Newboykin, 361; Mebane 141, 344; Mebane (A. D.), 335; Acala (Rogers), 334; Hurley Special, 327; Delfos 6102-531 A, 325; Stoneville No. 5, 317; Lonestar (Gorham), 315; and Kasch (Ed.), 312 pounds.

Spacing Cotton: The variety of cotton used for this test was Mebane 141 from the Chillicothe Station. The spacings desired were 3, 6, 9, 12, 18, 24, 30, 36, and 42 inches apart in the row and the stands were 100 per cent. The 6-inch spacing ranked first in yield with 390 pounds of lint per acre, followed by the 9-inch spacing with 359 pounds. The 18-inch spacing ranked third with 356 pounds of lint, followed by the 3-inch spacing with 329 pounds. The 24-inch spacing made the lowest yield of all, with only 258 pounds of lint per acre.

The thicker spacings were slightly earlier in maturity than the wider spacings. There was no difference in the staple length, as all plats averaged 15/16 inch.

For the six-year period, 1932-1937, the six-inch spacing ranked first in yield of lint with an average of 394 pounds per acre. The 9-inch spacing ranked second with 386 pounds, followed closely by the 3-inch spacing with 384 pounds. The other yields were as follows: 12-inch spacing, 378 pounds; 18-inch spacing, 366 pounds; 24-inch spacing, 341 pounds, and the 42-inch spacing 326 pounds of lint. These spacings give a range of from fewer than 4,000 plants to more than 58,000 plants per acre, yet the difference between the lowest and highest yield is only 68 pounds or about 20 per cent. This indicates that a very wide variation can occur in stands of cotton under irrigation where soil moisture can be controlled.

Dates of Planting Cotton: Mebane 141 was the variety used in this test. There were seven planting dates as follows: April 24, May 10, May 15, June 1, June 15, July 1, and July 15. The June 1 planting made the highest yield with an average of 327 pounds of lint per acre. The May 15 planting ranked second with 245 pounds followed by the May 10 planting with 223 pounds. June 15 was fourth with 222 pounds and April 24 was fifth with 216 pounds. The July 1 planting produced only 52 pounds of lint, while the July 15 planting failed to mature any bolls.

For the 7-year period 1931-1937, cotton planted between the dates of May 31 and June 3 ranked first in yield of lint with an average of 323 pounds per acre, followed by cotton planted April 20 to 28 with 270 pounds of lint per acre. Cotton planted May 15 to 21 ranked third with 258 pounds of lint per acre, followed by cotton planted May 1 to 10 with 247 pounds of lint per acre. Cotton planted June 15 to 20 averaged 199 pounds per acre.

Amounts of Irrigation Water for Cotton: The object of this test is to determine the proper amount of irrigation water to produce a normal crop of cotton in the irrigated valley. The total natural rainfall from planting date to the beginning of the picking period is added to the total amount of irrigation water applied (measured in inches). A pre-irrigation of 4 acre inches was given on April 29 and the total amount of water applied dates from the pre-irrigation to September 17. The test was planted May 15. Mebane 141 was the variety used.

Plats receiving a total of 28.89 inches of water ranked first in yield with an average of 364 pounds of lint per acre, followed by those receiving 23.89 inches with 352 pounds. Plats receiving 26.89 inches ranked third with 333 pounds of lint per acre, followed by those receiving 24.89 inches with 323 pounds. Plats receiving only the natural rainfall, which amounted to 12.89 inches, produced only 147 pounds of lint per acre. The addition of 16 acre inches of irrigation water produced an increase of approximately 68 per cent more than the dry land plats.

For the 6-year period 1932-1937, the plats which received an average of 29.64 acre inches of irrigation water ranked first with an average yield of 346 pounds of lint per acre, followed by plats which received 32.31 inches with 344 pounds. The lowest yields for the same period, 164 pounds of lint per acre, were secured from the plats which received only 13.98 inches of rainfall.

Grain Sorghum

Variety Test: Twelve varieties and strains of grain sorghum were included in this test. Club kafir ranked first with 29.1 bushels of threshed grain per acre, followed by Kalo with 25.4 bushels. Chiltex-x-hegari ranked third with 25.0 bushels per acre, followed by Algeria with 24.9 bushels. Quadroon (Hybrid No. 5) ranked third with 22.5 bushels per acre, followed by Chiltex with 21.8 bushels. Hegari made the lowest yield of only 9.1 bushels per acre.

Variety and Spacing Test: This test consisted of three varieties: Dwarf feterita, hegari, and Blackhul kafir No. 153, spaced 3, 6, 12, 18, and 24 inches. Dwarf feterita spaced 3 inches ranked first with an average yield of 23.7 bushels per acre, followed by Dwarf feterita spaced 12 inches with 22.3 bushels per acre. Dwarf feterita spaced 18 inches ranked third with 20.5 bushels, followed by the same variety spaced six inches with 20.0 bushels. The lowest yield was made by hegari spaced 24 inches with only three bushels of threshed grain per acre.

For the five-year period 1933-1937 Dwarf feterita spaced three inches ranked first with an average of 36.5 bushels per acre, followed by the same variety spaced 18 inches with 33.7 bsuhels. Hegari spaced three inches ranked third with an average of 33.5 bushels per acre, followed by hegari spaced six inches with 31.6 bushels per acre. For the same period, Blackhul kafir spaced 24 inches made the lowest yield of 21.1 bushels per acre.

Amounts of Irrigation Water for Grain Sorghum: The object of this test is to determine the proper amount of irrigation water and total water requirements for grain sorghum in the Wichita Irrigated Valley necessary to produce a normal crop. The total natural rainfall from the date of pre-irrigation on April 30 to the date of ripening, September 10, is added to the total amount of irrigation water applied (measured in acre inches). Spur feterita was the variety used this year.

Plats which received 28.89 inches ranked first with an average yield of 39.0 bushels of threshed grain per acre, followed by plats which received 27.89 acre inches with 38.7 bushels. Plats which received 34.89 acre inches of water ranked third with 37.4 bushels per acre, followed by plats which received 31.89 acre inches of water with 36.7 bushels. The lowest yield was made by plats which received natural rainfall only (12.89 inches) with an average of only 12.5 bushels per acre. The plats which received natural rainfall and pre-irrigation only (16.89 inches) gave an average of only 14.5 bushels.

For the six-year period 1932-1937 plats which received an average of 38.16 acre inches of water ranked first in grain production with an average of 40.9 bushels of threshed grain per acre, followed by plats which received 34.83 inches of water with 39.7 bushels. Plats which received 31.50 inches ranked third with 39.0 bushels, followed by plats which received 28.16 inches with 34.0 bushels. The lowest average yield for this period, 17.6 bushels, was made by plats which received 18.16 inches of water. The peak of production was reached with a total of 38.16 inches, but there was little difference in yields within the range of 31 to 38 inches of water applied.

Small Grain

Variety Wheat: Five varieties of wheat were used in this test, sown October 19, 1936, at the rate of five pecks per acre. Quivera ranked first with 17.6 bushels per acre; Kanred, 17.0 bushels per acre; Denton, 16.1 bushels per acre; Tenmarq, 15.5 bushels per acre. Clark's Blackhull made the lowest yield, 15.2 bushels per acre.

For the 4-year period, 1934-1937, Quivera produced an average yield of 30.7 bushels per acre; Tenmarq, 28.3 bushels; Kanred, 27.7 bushels; Denton, 27.0 bushels; and Clark's Blackhull 26.0 bushels.

Variety Oats: Five varieties of oats were included in this test, which was planted October 19, 1936, at the rate of ten pecks per acre. Texas Red Rust Proof No. 1118-69 produced 50.0 bushels per acre; New Nortex (Appler), 47.0 bushels; Nortex, 46.0 bushels per acre; Texas Red Rust Proof No. 1415-12, 45.3 bushels per acre; Frazier, 36.0 bushels.

For the 5-year period, 1932-1937, Texas Red Rust Proof No. 1118-69 produced an average of 56.8 bushels per acre; Nortex, 54.3 bushels; New Nortex (Appler), 44.4 bushels; and Frazier, 43.4 bushels.

Variety Barley: In the test with five varieties of barley planted at the rate of 6 pecks per acre, October 22, 1936, Bailey produced 38.6 bushels per acre; Finley, 29.5 bushels per acre; Wisconsin Winter, 29.1 bushels; Tennessee Winter No. 15826, 27.8 bushels; and Tennessee Winter No. 18561, 25.3 bushels.

Legumes

Winter Legume Variety Test: This test included twenty-two varieties of legumes and grasses, planted October 6, 1936. Both inoculated and non-inoculated seed were used for each variety. There was no indication of any benefit from inoculation on most varieties.

In the production of dry forage Italian Rye grass ranked first with 1.86 tons per acre. Common alfalfa ranked next with 1.54 on the non-inoculated plats and 1.17 on the inoculated plats. Hairy Peruvian alfalfa produced 1.40 tons with inoculation and 1.19 tons without inoculation, followed by Hairy Vetch with 1.12 tons on inoculated plats and 0.70 tons on non-inoculated plats. Dallas grass failed to germinate on any plats and the germination of spotted leaf bur clover and crimson clover was poor. Canada field pea, alsike clover, and White Dutch clover winterkilled. Other varieties made yields ranging from a few pounds to almost a ton per acre. No seed yields were obtained.

Summer Legumes: This test consisted of fifteen varieties as follows: three velvet beans, two cowpeas, four soybeans, two crotalarias, and one each of sesbania, guar, mung bean, and beggarweed. Guar produced an average yield of 1.02 tons of dry foliage per acre; sesbania, 0.91; Brabham cowpea, 0.45; Chinese Red, 0.44. Both varieties of crotalaria, beggarweed and O-Too-Tan soybean, failed to germinate to stand. Osceola velvet bean made the lowest yield of dry forage, 0.16 ton per acre. Guar produced an average of 750 pounds of seed per acre; Chinese Red Cowpea, 186; mung bean, 72. Other varieties failed to mature seed.

Velvet beans and Sesbania showed some benefit from inoculation. Other varieties gave about the same yields from inoculated seed as from non-inoculated seed.

Crop Rotation Studies

This project consists of studies with eleven combinations of rotations comprising continuous cropping, 2-year rotations, 3-year rotations, and 4-year rotations of cotton, small grains, grain sorghum, and alfalfa.

Cotton in a two-year rotation of hegari and cotton, ranked first with 303 pounds of lint per acre, followed closely by cotton in a three-year rotation of cotton, oats, and alfalfa, with 302 pounds. Cotton in a three-year rotation of cotton, hegari, and oats, ranked third with 299 pounds of lint, followed by cotton in a two-year rotation of cotton and Hegari (stover removed) with 290 pounds per acre. Continuous cotton (cotton every year on the same land) made the lowest yield, 270 pounds of lint per acre.

Grain sorghum (hegari) in a two-year rotation of cotton and hegari (stover removed) ranked first with 38.6 bushels of threshed grain per acre, followed by hegari in a four-year rotation of alfalfa (2 years), cotton and hegari, with a yield of 37.2 bushels. Hegari on Rotation No. 1, continuous grain sorghum ranked third with 30.93 bushels, followed by Hegari on Rotation No. 6, a two-year rotation of Hegari (stover plowed under) and cotton, with 26.12 bushels. Hegari on Rotation No. 7, a two-year rotation of Hegari (stover removed) and cotton made the lowest yield of 24.32 bushels per acre.

Continuous oats ranked first with 37.2 bushels per acre, followed by oats in a three-year rotation of cotton, oats, and alfalfa, with 36.9 bushels. Oats in a three-year rotation of cotton, oats, and hegari (stover plowed under) made the lowest yield, 17.7 bushels per acre.

Second year alfalfa in the four-year rotation of alfalfa (2 years), cotton and hegari (stover plowed under) ranked first with 3.4 tons of dry hay per acre, followed by continuous alfalfa for six years, 1.08 tons. Alfalfa in the three-year rotation of cotton, oats, and alfalfa made the lowest yield, 1.02 tons of dry hay per acre.

During the six years 1932-1937, continuous cotton made a larger average yield than cotton grown in rotation, producing 407 pounds lint per acre. Cotton in a two-year rotation of cotton and grain sorghum (Hegari, stover removed) made an average yield of 334 pounds.

The largest average yield of hegari, 35.4 bushels per acre, was obtained from the 4-year rotation of cotton, hegari, and alfalfa (2 years).

The lowest yield of hegari (30.7 bushels per acre) was obtained where the crop was grown on the same land every year.

The best average yield of oats for the six years, 61.6 bushels per acre, came from the three-year rotation of cotton, oats, and alfalfa.

Continuous alfalfa for the six years produced the highest average yield, 3.41 tons per acre. Alfalfa in a three-year rotation made the lowest yield, 2.18 tons per acre.

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Fruit Adaptability Studies

Peaches: Late spring freezes on March 28 and April 5 caused a complete loss of the fruit crop except on the very hardiest and late blooming varieties. Carman, Dr. Burton, Early Wheeler, Smith Indian, PI Nos. 35201, 43124, and 55886 came through with a fair to good crop. Carman with twelve trees averaged 187.2 pounds per tree; Dr. Burton with five trees averaged 150 pounds per tree, and Early Wheeler with seventeen trees averaged 83.8 pounds per tree. A single tree of PI No. 55886 yielded 125 pounds, and three trees of PI No. 35201 averaged 82.7 pounds per tree. Two trees of Smith Indian averaged 62 pounds and a single tree of PI No. 43124 yielded 50 pounds. Such varieties as Belle of Georgia, Early Elberta, J. H. Hale, PI No. 55563, PI No. 55564, PI No. 63850, Family Favorite, Robert E. Lee, Fredericka, and Elberta averaged from 5 to 25 pounds per tree, while Hiley and Shalil averaged less than 5 pounds per tree. Varieties of peaches that failed to mature any fruit this season were Minnie Stamford, Leona, Salway, Slappy, Crosby, Old Mixon Cling, Handy, Heath Cling, and a number of U. S. Department of Agriculture introductions.

Plums: The Munson plum, although early in bloom, is quite hardy and escaped freeze damage, having the highest yield of any variety, an average of 84 pounds per tree. Gold ranked second with 54.5 pounds per tree, followed by Waneta with 51.5 pounds. Opata averaged 36.6 pounds, America 36.2 pounds, and Sapa 33.2 pounds. Gonzales, Minco, Sharp's Early, PI 38282, Yellow Iowa, Compass Cherry, Methley, Hanska, Milton, and Omaha ranged between 10 and 25 pounds per tree. Happiness, Santa Rosa, Sultan, Tragedy Prune, Kernuca, Mariana, and Red June ranged between 1 and 10 pounds per tree. Advance, Alpha, Best's Hybrid, Bruce, May Beauty, Wickson, Wright's Early, and a few U. S. Department of Agriculture introductions failed to fruit.

Apricots: A heavy set of apricots with fruits up to ½ inch in diameter was completely destroyed by the late spring freezes.

Nectarines: Quetta yielded 25 pounds of fruit per tree. All others were caught by late spring freezes.

Grapes and Berries: Of twenty varieties of grapes set out in 1931, only Champanel survives 100 per cent with all healthy plants. Lukfata, Ladano, Elvicand, and Headlight survive, but some plants are definitely weakened by disease. All other varieties have died out completely on account of cotton root rot.

The berry crop was light because of the late spring freezes. Dallas Blackberry produced more fruit than any other variety this season because of its late fruiting habit. McDonald ranked second with a very light crop, and the dewberries and Youngberries matured only a few fruits.

Vegetables

Adaptability Studies: One hundred varieties of vegetables representing eighteen different kinds were included in the tests for 1937.

Burpee's Stringless Green Pod and Bountiful produced only about half as much as Pinto this year.

Detroit Dark Red continues to be the leading table beet.

Golden Acre and Early Jersey Wakefield produced a fair crop where they were started early.

A number of varieties of leaf lettuce emerged to poor stands but were excellent for early harvest.

Twenty-two varieties and strains of cantaloupes were included in the adaptability tests this year. Extra Early Hackensack ranked first in yields with 86 crates of 45 melons each per acre, followed by Mildew Resistant No. 50 with 84 crates. Edwards Perfecto and Rocky Ford tied for third place with 79 crates, followed by Hale's Best No. 112 with 77 crates. Imperial Sunset made the poorest showing with only a few fruits matured.

Sixteen varieties and strains of cucumbers were included this season. Always Green ranked first with 12,155 pounds of marketable cucumbers per acre, followed by Earliest of All with 10,065 pounds. Jersey Pickle ranked third with 8,669 pounds, followed by Longfellow or Vaughan with 8,442 pounds. Early Fortune, A and C Special, Landreth's Extra Early White Spine, Straight Eight and Early Frame all yielded over 7,000 pounds. New Hybrid made the lowest yield of 4,822 pounds.

Only one variety of eggplant, New Orleans Market, was grown this season. It was very satisfactory as a late summer crop, producing an abundance of fruit on to the first frost.

Yellow Bermuda onions transplanted to the field in March produced a fair crop.

Premium Gem and Bliss Everbearing peas made rather poor yields. Giant Butter was tried for the first time and merits further trial.

Long Scarlet and Icicle continue to be the leading varieties of radishes.

White Bush and Yellow Summer Crookneck squash made good yields. Fordhook and Table Queen set only a few fruits before being destroyed by Squash bugs.

A number of varieties of tomatoes failed to set fruit on either transplants or seedlings grown directly in the field until after the late August rains. Yields at rates of from less than 1,000 to more than 16,000 pounds per acre were harvested between October 21 and November 15, the date of the first killing frost. Varieties warranting further trial are Pritchard, Avon Early, Greater Baltimore, Chalk's Early Jewell, and Small Red Prolific.

Onion Seed Production Test: A yield of 378 pounds of floated and recleaned seed per acre was obtained this year. This is the second best crop since 1932. Slight damage was done by thrips, which constitute the only apparent hazard thus far to onion seed production in this valley.

Fertilizer Test with Asparagus: This test is located on Miller silty clay loam, which is a heavy soil that bakes and cracks severely. For the six-year period 1932-1937, the treatment of barnyard manure at the rate of 20 tons per acre ranked first with 2,112 pounds of merchantable tips per acre. Plats which received 400 pounds of 4-8-4 fertilizer per acre yielded 1,485 pounds of tips, and plats which received 400 pounds of 4-8-4 plus 200 pounds of ammonium sulphate yielded 1,319 pounds of tips per acre, while the untreated check plats averaged 1,430 pounds of tips per acre.

Green Manure as a Soil Improver: This test was started in 1934. The green manure crops being tried are Redtop sorghum and cowpeas. Spinach is the indicator crop. The immediate effect of 30.8 tons of green cane and 15.2 tons of cowpeas turned under in the fall of 1934 was a decided decrease in the yields of spinach under both treatments in the spring of 1935. Plats that have received the green manure treatments each year, continue to give depressed yields, while plats that received the green manure treatment only one year, and have since been summer-fallowed have slowly recovered normal production.

Shade Trees and Ornamentals

Trees native to this section of the State are proving most dependable for shade trees. These include pecan, hackberry, western soapberry, mesquite, cottonwood and sycamore. The cottonwood is short lived, but it grows rapidly and produces shade in just a few years. Hackberry and western soapberry are very slow growing, but hardy. The sycamore is popularly condemned because of its tendency to shed its leaves so early in the fall. The mesquite is hardy and attractive and, although it makes a poor shade, should have a place in the landscape plan. The Russian mulberry is used to advantage; although susceptible to root rot, it has the ability to live on with the disease. *Chilopsis linearis* (flowering willow) is both hardy and attractive as a specimen plant.

Coniferous evergreens that have proved to be adapted to local conditions are: red cedar, Pfitzer's juniper, Arizona cypress, and a large number of the arborvitaes. In the broad leaf group of evergreens, a number of ligustrums, pyracanthas, jasmines, and nandina are proving desirable for specimen, group and foundation plantings.

Of the deciduous shrubs tried here, *Vitex agnus castus* is proving indispensable to the farmstead planting, especially in locations where the ground is poor and it is difficult to get other things to grow. The common salt cedar is a hardy shrub suitable for screens, specimen, or hedge, and may be pruned so as to provide shade. The native coral berry is hardy and quite suitable for group or foundation plantings.

Some attention is being given to the use of native plants as ornamentals. The following are being used successfully on the station grounds at present: (shade trees) *Sapindus Drummondii, Celtis holleri,* and *Prosopis juliflora glandulosa;* (shrubs) *Amorpha fruticosa, Condalia obtusifolia, Baccharis angustifolia* and *Symphoricarpus vulgaris;* (perennials) *Liatris punctata, Tradescantia virginiana;* (annuals) *Gaillardia pulchella, Corydalis montana,* and *Lindheimera texana.*

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Root Rot Studies

Sorghum as a Root Rot Remover: A field known to be severely infested with cotton root-rot fungus has been planted to Redtop sorghum cane for four years in succession and will continue to be planted to grass crops for a number of years to determine whether the fungus can be killed out by continuous cropping with a non-susceptible grass crop.

Cotton from X-rayed seed: This test was started in 1935 with 950 samples of seed supplied by the Division of Plant Pathology. These seed were produced by stalks grown from X-rayed seed. From the 1935 plantings, individual selections of all healthy plants were made and the seed saved for 1936 plantings. The same procedure was carried out in 1936 and 1937, with the hope that some resistant selections might be found. However, there is little encouragement to date.

Grape Resistance: The object of this experiment is to test the hardiness of various grape stocks which have shown marked resistance to root rot in some localities. The test was begun in 1934 and has involved a large number of grafted plants and rooted cuttings of the following stocks: Champanel, Lomanto, Lukfata, Black Spanish, Dogridge, La Pryor, Mustang, Cloeta, Candicans, Ladano, *Vitis Champani, V. cineraea,* and *V. rupestris.* Results thus far have shown that these stocks are not entirely immune from root rot, but that most of them are decidedly more tolerant of the disease than grape stocks commonly used.

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SUBSTATION 19, WINTER HAVEN

Substation 19 is located in Dimmit County, between Carrizo Springs and Crystal City, in the center of a large area specializing in the production of vegetables with irrigation. Rainfall averages 21 inches annually but winters are mostly dry. The substation, comprising 192 acres, is located on fine sandy loam (mostly Webb and Crystal series) with about 100 acres in cultivation. Irrigation water is supplied by pumping with electric power.

The purpose of the substation is to study production problems of vegetables, fruits, and other plant crops, particularly under irrigation. The more interesting developments of our work during 1937 were breeding work with strawberries, tomatoes, and onions; adaptability tests with dates, satsumas, and peaches; cultural tests with onions; interest in canning crops; and the addition of a plant pathologist. Work with insects will be found under the Division of Entomology report.

The year was unusually dry with the exception of January and December and crop results were affected accordingly. Some injury from hot summer temperatures occurred on citrus; on the other hand, this was beneficial to dates, all the varieties of which ripened successfully this season. Absence of killing frosts early in the year permitted over five months of strawberry production, but an early killing frost on November 20 was disastrous to the fall crops of tomatoes, peppers, and eggplant.

Fruits

Adaptability Studies:

Apples set a fairly good crop of fruit in 1937, indicating that dormancy was favorable. Bledsoe and Helm gave the best yields. Helm is useful as a dessert apple, while Bledsoe is a cooking apple.

Apricots yielded less than in 1936 and only Tilton and Trevatt produced satisfactorily. Tilton is apparently more dependable.

Avacados set a good crop, but hot weather in August caused most of them to fall off without ripening properly.

Advance and Rogers were the only berry varieties that bore satisfactorily this season.

Feijoas failed to ripen properly.

Psidium guajava (lemon guava) bore a good crop of fruit.

Figs bore a good crop in the summer.

Nectarines all failed to set fruit.

Forty-eight of the sixty peach varieties bore fruit in 1937. Only twenty of these had satisfactory yields, the best of which were Imperial (July 26-August 20), Luken's Honey (July 7-14), Frank (July 26-August 12), Pallas (July 7-16), I-16 (July 30-August 14), and Smith (June 9-21). Over a period of years the most useful varieties in the orchard appear to be Belle (early July), Frank (early August), Imperial (August), Katherine (late July), Luken's Honey and Pallas (July), Smith (late June), and PI 61302 (early July). Japan Dwarf is the only very early variety that is dependable, but it is of poor quality.

Douglas and Pineapple pears bore some fruit.

Of twenty-one varieties of plums the earliest were Bruce, Methley, Red June, Advance, and Munson. Heaviest yields were secured from Munson, Burbank, Jacob, Happiness, Santa Rosa, and Excelsior. Over a period of years the most dependable producers seem to be Munson, Excelsior, Happiness, and Gonzales. The best of these for early markets are Bruce and Methley.

De Antequera quince bore the fifth consecutive crop.

Citrus Varieties: Good yields from satsuma varieties were obtained from trees four years old or more. Yields in some varieties ran over 200 pounds per tree, but some other varieties of the same age failed to bear at all. The best yields were secured from Owari, Foley 11481, Horie Wase, Kawano Wase, Silverhill, and Sueoka Wase. The earliest to ripen were Morita Wase, Higuchi Wase, Ishikawa Wase, and Hozaki Wase. Several varieties seemed to have exceptionally good quality for eating, such as Morita, Yamada, and Horie. For shipping, Owari, Silverhill, and Kawano Wase seem the best so far.

Best yields from six orange varieties were from Louisiana Sweet, Washington Navel, Purvis, and Joppa. Hamlin and Washington Navel are nearly seedless and of good quality.

Meyer lemon produced a heavy crop.

Clementine tangerine seemed promising for market.

Lakeland and Eustis limequats both bore well.

Fruit was also secured from kumquats, grapefruit, and tangelos.

Citrus Rootstocks: Trees of various varieties have been grown to produce seed for stocks. Many of the hybrids fail to produce seeds or have only a few seeds per fruit. The best seed production this year was from Changsha orange, Kansu orange, and Thomasville citrangequat.

The tests on various stocks for satsumas are scarcely far enough advanced to draw any conclusions. Kawano Wase gave better yields in TS 15137 (citrange) than on Cunningham or Savage Citranges. Silverhill yielded much better on Cunningham than on other citranges.

Some striking results are appearing in the test of orange root-stocks. Joppa orange is decidedly dwarfed on trifoliata stock and the yields per tree are greatly reduced. Very little difference between trifoliata and citrange stocks is noticeable with Hamlin, Texas Navel, or Clementine tangerine.

Date Investigations: A good fruit yield was secured from most varieties and a number of seedlings bore fruit. Of thirteen named varieties that bore fruit, Amir Haj, Kustawy, and Braim were considered the most promising. The earliest variety to ripen was Anmary which began ripening in late July and was followed by Koroch and Hayany. Three good seedlings were found. The fruit was cured successfully in the sun, where temperatures as high as desired were secured on a table. Several offshoots of the Braim variety were transplanted in May.

Grape Varieties: Fruiting records were obtained from seventy-two varieties ripening from June 1 to Agust 1. The best *early varieties* were Lomanto, Monukka, and Khalili; *ripening in the latter part of June*, Sultanina (Thompson Seedless), Sultanina Rosea, Chasselas Fontainebleau, Alicante Bouschet, Zinfandel, Choeta, and Manito were the best; *ripening in early July*, the best varieties were Red Champini, Champanel, Black Spanish, Black Muscat, Dattier, Brilliant, Extra, and Salamander; for *late grapes*, Tokay, Grenache, Marguerite, and Last Rose gave best yields.

Grape Rootstocks: Tests with stocks in 1937 were limited to three seedless varieties, Sultanina, Sultanina Rosea, and Monukka. Treatment of stocks with indole-acetic acid seemed to be of some benefit in the per cent of "take." Sultanina gave the best "take" with Champanel followed in order by La Pryor, Dog Ridge, and TS 22354 *(candicans)*. Monukka gave best results in order on TS 22381 (wild grape), Dog Ridge, TS 22379 (wild), La Pryor, and Champanel. Sultanina Rosea gave best "take" in the following order: Dog Ridge, Champanel, La Pryor.

Differences in fruiting on various stocks are indicated in the vineyard, but no definite conclusions have been established.

Strawberry Variety Adaptability and Breeding: Results of variety tests were published during the year in Station Bulletin No. 556.

Of the sixty-seven strawberry selections tested in 1937, twenty-two gave better fruit yields than Missionary. Considerable heat resistance was shown by twelve of the selections during the summer. Good plant production was secured from most of the better selections. At least ten were found to be valuable for market, five for home use, and four selections seemed to be of especial value for canning.

E. Mortensen.

Vegetables

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

Variety Descriptions: The object of this work has been to obtain definite descriptions of generalized types of the more widely used vegetable varieties. Notes on the third and last year's trials of turnips and rutabagas were completed in the spring of 1937. These included thirty-seven strains of turnips representing sixteen varieties, and fourteen strains of rutabagas representing thirteen varieties. So far as the conclusions affecting the Winter Garden Region are concerned, they are much the same as in the previous two years. Turnips in general are well adapted, but rutabagas are only fairly so. However, some varieties of the latter that grow very well are as follows: Early Neckless, which can be recommended above all others, Ditmars Bronze Top, and Early Perfection White.

In the late summer and fall the first crops of peppers and eggplants were grown in connection with these same varietal studies. In the pepper trial there were 149 strains representing twenty-eight sweet varieties and sixteen hot varieties. In the eggplant test there were thirty-nine strains representing ten varieties. The main objective of the work this year was to choose the strains for detailed descriptions in future seasons. It was apparent that eggplants will set fruit under hot dry conditions better than peppers. Neapolitan was practically the only sweet pepper variety to set fruit under such conditions. Most of the varieties of commercial importance, especially California Wonder, Early Giant, and Ruby King entirely failed to set fruit under hot, dry conditions, and when in late September temperatures became somewhat more moderate and the relative humidity increased slightly, the fruit which did set was small, misshapen, and off-type. As weather conditions still further improved, the shape and appearance of the fruit became more normal.

Adaptability Studies: During the year Bulletin 546, "Further Tests of Vegetable Varieties for the Winter Garden Region," was published. This bulletin reported upon the adaptability of 169 varieties grown since the publication of Bulletin 508 in 1935. It covered dwarf lima beans, sweet corn, edible cowpeas, cucumbers, muskmelons, rutabagas, tomatoes, and turnips.

During the past year the following numbers of varieties and strains of vegetables were included in the trials: asparagus, 10; table beets, 18; carrots, 29; Chinese cabbage, 3; okra, 14; spinach, 91; sweet corn, 12; tomatoes, 19; and watermelons, 55. This made a total of nine crops and 251 varieties and strains.

The asparagus was again a disappointment, and especially so after the fairly promising performance it gave in 1936. Following its failure to produce in 1937, it was decided that asparagus is not adapted commercially and plans to plow up the patch were made.

All varieties of carrots showed improvement in interior appearance over the trials of previous years. Some strains of Nantes and Morse's Bunching were excellent in redness and smallness of core. Regular strains of Danvers Half Long still had too many large, yellow cores to be considered a high quality variety, but a strain labelled Special Half Long was a striking exception.

No variety of table beets showed any noticeable improvement over those seen in previous years. As usual all beet varieties had good appearance and quality.

The collection of spinach varieties included most of the standard varieties, besides a number of strains collected by the Division of Foreign Plant Introduction, U. S. Department of Agriculture, as well as some special strains from other sources. The chief objective of the trial was to find varieties resistant to curly top disease. Since the disease was entirely absent during the growing season, no progress in that direction was made; all varieties made excellent growth.

Among the tomatoes Stokesdale again gave promise as a spring variety. Grothen's Globe failed to yield as well in the spring as it does in the fall. The shape was excellent. In the fall Nystate, Stokesdale, and Pearson yielded very well and in the order named. The first two are new varieties, more or less of the Bonny Best type. Marglobe again yielded less than any other variety in the test.

Three crossed strains of Iogold, a Golden Bantam type of sweet corn from Iowa, namely, Iogold 13.45, Iogold P.39.I.45, and Iogold P.51.I.45, were again very promising this year, all being relatively resistant to corn earworm and of excellent eating quality. Mosshart x P39 produced in Texas evhibited as much resistance to the earworm as did the strains of Iogold. It had larger ears and good quality but not as good as the Iogold strains. Tuxpan Sugar and Mosshart Sugar showed the most resistance to corn earworm, excelling Honey June in this respect. Both varieties suffered in yield, however, by being late. Mosshart Sugar is a yellow variety.

Among the okra varieties White Velvet was the most productive, and seemingly one of the most satisfactory varieties to grow. Perkins Mammoth Podded Long Green, although a well known variety, yielded less than White Velvet, and was not as good a variety. Most varieties had pods six to eight inches long. Those having shorter pods were Landreth's Dwarf Stalked with pods only four to five inches, and the Cuban, New Market, and French Market varieties with pods three to four inches long.

The earliest watermelon varieties in 1937 were Early Kansas, Cole's Early, and Northern Sweet. Varieties under test at the Station for the first time, and showing considerable promise, were Northern Sweet and Early Arizona for home use, Florida Giant and Texas Sweet for large size and commercial possibilities.

Spinach Irrigation: Another test was conducted in which the frequency of irrigation was varied according to the rate of evaporation from a clear water surface. Again the treatments irrigated at infrequent intervals resulted in higher yields than those irrigated more frequently.

Onion Fertilizers: Since the completion of the major fertilizer project with Yellow Bermuda onions, work along this line has been restricted to experiments in fertilizer placement and in determining the different values of materials carrying phosphoric acid. For three consecutive seasons the placement of 600 pounds per acre of 6-12-6 fertilizer has resulted in higher yields than where the same amount of fertilizer has been broadcast. The results from the test of phosphoric acid carrying materials are somewhat indefinite after two years. The higher analysis materials, such as 32 and 45 per cent superphosphates, are not necessarily the most satisfactory materials. However, a high analysis fertilizer carrying nitrogen as well, such as 11-48-0 fertilizer, has proved very satisfactory.

Supplementary Onion Fertilizer Tests on Additional Soil Types: Since all fertilizer experiments at the Station have been conducted on a sandy loam soil, some tests were initiated on Laredo silt loam at Laredo and Eagle Pass, and on a Monteola clay at Big Wells. In addition to a no-fertilizer treatment there were five other treatments, all applied at a rate of 600 pounds per acre: 6-12-6, 6-12-6, plus a nitrate side dressing in January or February, 6-18-0, 6-18-6, and 6-18-12. In general, the results were not very conclusive. At Eagle Pass the nitrate side dressing apparently increased yields; and at none of the places did the omission or addition of potash have any consistent effect.

Transplanting Practices with Onions: This season completed five consecutive years of tests involving transplanting and other cultural experiments with Yellow Bermuda onions. A report entitled "Cultural Experiments with Yellow Bermuda Onions Under Irrigation" has been published as Station Bulletin No. 561. Medium ("pencil") sized plants have been the most dependable plants to set out, usually resulting in the highest yields. Small plants consistently yield poorly. Large plants may occasionally give very high yields, but in general result in too many splits, doubles, and seedstems to make their use profitable in most seasons. Plants transplanted without any pruning to their tops or roots in the average season will outyield those which have been so pruned, and often outyield those having only their roots pruned or their tops cut back.

Rates of Seeding: Because of the effect of plant size at transplanting time on the final yield (see above), tests have been made with various rates of seeding to determine what rate will give a good proportion of medium sized plants and also a sufficient number of plants per acre. So far it has not proved practical to hand-grade the plants for size. Rates of seeding ranging from around four to over forty pounds of seed per acre have been tried. Results have indicated that seventeen to twenty pounds of seed per acre, provided germination is high, is sufficient to produce enough plants to set about ten acres with plants of fairly good size. Lower rates of seeding, while resulting in a higher proportion of desirable sized plants, hardly produced enough plants per acre of seed bed to make the practice profitable.

Pruning Tomatoes: For the second year in succession pruning tomatoes to one or two stems resulted in higher early yields than where the plants were left unpruned. Pruned plants also usually had ripe fruit earlier. After the first six pickings the unpruned plants bear more heavily than the pruned ones, but by that time the value of the fruit has dropped considerably. The greater yield from the pruned plants is chiefly a result of the closer planting, pruned plants being spaced one and one-half feet apart in 3-foot rows, while the unpruned plants were set two feet apart in 4-foot rows. Where plants are plentiful, however, these tests would indicate that it pays to prune and to set them closer together in the field.

Storage of Cucumbers: Cucumbers were wrapped in moisture-proof cellophane, stored at room temperature, and checked with unwrapped cucumbers. Yellowing of cucumbers so stored was more marked in the wrapped than in the unwrapped fruit. Wrapping seemed to increase decay, and at the end of sixteen days 37 per cent of those wrapped were decayed, while in comparison not one unwrapped fruit in the lot was decayed at the end of the period. Further report of the storage and wrapping of cucumbers will be found under the Division of Rural Home Research.

Breeding Vegetable Crops: Promising F_4 and F_5 selections of a cross originally made between Large Cherry and Bonny Best were planted for trial in the summer of 1937. Several of these, but notably strain B-1-5, showed considerable uniformity in plant and fruit characters. As in previous years most of the fruit had no seed during July, August, and September. However, the seedless fruit is juicy and of good quality during that time. Canned juice prepared in November from these tomatoes had excellent color and quality. Further selections were made and some of these have been released for trial by home gardeners under the name Summerset.

Various second generation inbred onion selections were selfed during the spring. Blow flies were used as the pollinating agents. Sixteen plants of the best inbred strain were massed together under one large cage and allowed to cross-pollinate. Other plants in this same strain were individually selfed.

A number of White Persian bulbs, as well as bulbs representing crosses between Crystal Wax and White Persian were harvested. A few of these showed some promise for first generation material, but in general the bulbs of White Persian were severely doubled, and the hybrid material was often the same way. Whether thrips resistant onions of a good type can be selected or bred out of this material remains to be seen.

L. R. Hawthorn.

Plant Diseases

A survey of the diseases in the Winter Garden area during the period of September to December has shown the prevalance of a number of destructive diseases of all types. The virus diseases, however, from the standpoint of their number and spread, constitute probably the most important class of disease in this area. The reasons for this characteristic prevalence of the virus diseases are probably to be sought in the peculiar climatic and environmental conditions which characterize the region. Cultivation of various vegetable crops throughout the year no doubt is a factor in the occurrence and spread of some virus diseases. Crops affected with viruses having a wide host range make available a continuous supply of fresh and abundant inoculum throughout all seasons. Likewise the low relative humidities and the mild winter favor the survival and multiplication of some insect vectors. At present the curly top of spinach ranks first in importance among the virus diseases because of the importance of the spinach crop in this area. Other important virus diseases are the common tobacco mosaic, which affects a number of crops, cucumber and bean mosaics, spotted wilt on tomatoes, and others.

The fungus diseases come next in importance. Diseases like downy mildew of spinach caused by *Peronospera effusa* (Grev.) and pink root of onions are widely spread and deserve particular attention on account of the economic importance of the crops they affect. There are other diseases the nature of which is not well understood and which require further study, such as eggplant "yellows," onion blight, and perhaps some others.

The control of the most important diseases needs to be worked out in different ways according to the nature of the specific disease concerned and the technique and equipment available. There is no doubt that the destructive effect of some of these diseases could be reduced by seed and soil treatments, by dusing or spraying the crop, by adapting different culture methods, and by practicing sanitation. Other diseases, however, such as curly top and downy mildew on spinach, pink root of onions, and others, probably could be effectively controlled only by the development of disease resistant varieties.

A beginning has been made towards the establishment of a laboratory for research on plant diseases. Equipment is now available for isolating and culturing microorganisms. More equipment will be necessary, however, for the study of certain virus and fungus diseases, including the acquirement of a greenhouse.

S. S. Ivanoff.

Ornamentals

Native Trees and Shrubs: Successful rooting with dormant cuttings of native trees and shrubs was secured with mulberry, sycamore, flowering willow *(Chilopsis linearis)*, *Baccharis* Sp., button-willow *(Cephalanthus occidentalis)*, *Fallugia paradoxa*. Indoleacetic acid was tried without response on dormant cuttings of sycamore and *Condalia obovata*.

E. Mortensen.

Field Crops

Corn Varieties: Very dry weather occurred during most of the growing period and resulted in a large percentage of barren stalks. Indian Soft gave the highest yield with 20 bushels per acre. Reese, Yellow Surcropper, and Golden June showed up very well. Over a six-year period Surcropper and Reese have yielded best.

Cotton Varieties: In 1937 the cotton test was irrigated very carefully to avoid moisture deficiencies that might cause shedding. Boll weevils were also controlled by dusting with calcium arsenate. Good results were secured and yields of the five best varieties in pounds of lint are as follows: Rogers Acala, 750; Half and Half, 794; Mebane 4120, 657; Startex 619, 562; and Shafter Acala, 551.

Sesame was planted at various times to get an idea of yields. Plantings in May seemed best, and Mexican seed gave better yields than American seed. The Mexican seed produced about 1,100 pounds per acre of harvested seed. It is necessary to harvest by hand to prevent shattering.

Flax was grown on Crystal fine sand and Punjab yielded 17 bushels per acre and Abiladigo, 16 bushels. Better yields than this were reported from darker soils along the Nueces river at Crystal City.

Winter Legumes and Grasses were attacked by rabbits and birds when emerging and poor stands resulted. The highest yields of dry forage per acre was from Italian rye grass with nearly 5 tons. Austrian winter peas, hairy vetch and hubam clover gave about 3 tons per acre.

Sugar Cane: The sugar cane moth-borer is so common in this area that ordinary varieties of sugar cane are usually ruined. In an attempt to secure borer-resistant varieties, a small amount of five varieties was secured from the U. S. Bureau of Plant Industry through Dr. Brandeis.

Of these POJ-36M was destroyed because of mosaic and borer damage was found to be severe in CO 290 and CP 29/116. Considerable resistance to borers was shown by CP 28/19 and CO 29/320. No tests for syrup were made, as all available canes were saved for seed.

E. Mortensen.

Insect Investigations

Beet leafhopper: Populations of the beet leafhopper, *Eutettix tenellus* (Baker), the insect responsible for curly top on spinach and other crops, were much lower in 1937 than they were during the previous year. The insects migrated into the Winter Garden on October 17 and 27, 1936, and were present throughout 1937. Migrations during the fall of 1937 occurred on October 8 and November 9. Both migrations were light. Surveys made during the year showed that the migrations of the beet leafhopper into the Winter Garden in the fall of 1937 did not come from the area extending from the Winter Garden northwest to Pecos County, although the migrations were accompanied by northwest winds.

M. J. Janes.

Eggplant yellows control: Eggplants grown in the Winter Garden are affected each year by a disease which is known as eggplant yellows. The malady appears in many respects to be a virus disease and indications are that it is transmitted by an insect vector. Affected plants become conspicuously yellowed, stunted in growth, and fail to produce a normal yield of marketable fruit. Commercial fields have been observed in which approximately 100 per cent of the plants have been affected. Complete control of eggplant yellows was obtained by dusting the plants with sulphur and with sulphur in combination with other materials at 7, 10, and 14 day intervals, beginning in the seedbed and dusting throughout the season.

M. J. Janes.

H. obsoleta (Fahr.): The infestation of the insects was much lower than during previous seasons and injury in general was light. Rather consistent control, however, was obtained by the dust applications. Diluting the calcium arsenate 50-50 with either sulphur or hydrated lime reduced the control only slightly. Diluting to 25 per cent calcium arsenate and 75 per cent sulphur showed increased reduction in control, but the reduction was still rather light. Dust applications were made early in the season while the fruits were small. In a preliminary test cryolite-sulphur 20-80 was also effective in reducing fruitworm infestation.

M. J. Janes.

Cabbage worms: A light infestation of larvae of the diamond back moth *Pentella maculipennis* was controlled equally well by means of a sulphur-pyrethrum mixture containing .125 per cent pyrethrius and by a sulphur-rotenone mixture containing .5 per cent rotenone. The pyrethrum mixture was not as effective as the rotenone dust in controlling cabbage loopers, *Autographa brassicae.*

M. J. Janes.

Onion thrips: Onion thrips, *Thrips tabaci* Lindeman, population was comparatively low during 1936-1937. Studies for the purpose of determining the extent of thrips infestation transfer from the seedbed to the field by means of eggs have shown that considerable numbers of eggs are present in the onion plants in the seedbed at transplanting time and that the leaves remain succulent long enough after transplanting to enable the majority of the eggs to hatch normally.

No significant control of thrips was obtained by sulphur arsenical or sulphur cryolite mixtures.

M. J. Janes.

California red scale: The California red scale, *Aonidiella aurantii* (Mask.), became so abundant on citrus at Carrizo Springs that an extensive spray program was established. The insect is now widely distributed in the Winter Garden.

Anychus clarki McG.: This mite was abundant on citrus throughout most of the year. Citrus at the Substation was sprayed three times for this pest. Wettable sulphur was used with good results.

Spinach budworm: The spinach budworm, *Hylemyia cilicrura* (Rond.), was a major pest on spinach during December 1936-January 1937. A considerable amount of spinach was abandoned as unsuitable for shipment.

Blister beetles: The blister beetle, *Macrobasis albida* (Say), was injurious to tomatoes and eggplants at several points in the Winter Garden. At the Substation approximately half an acre of eggplants was almost completely defoliated on September 5.

Cucumber beetles: The twelve-spotted cucumber beetle, *Diabrotica duodecimpunctata* (Fahr.), became unusually abundant in the Winter Garden during September. They were injurious to a variety of crops, including cantaloupe, squash, okra, cow peas, and others.

E. Mortensen.

Paratrioza cockerelli (Sule): This species became abundant on tomatoes again in November, 1937, at which time it was found in low numbers on peppers and eggplants.

M. J. Janes.

For other insect investigations see report of Division of Entomology.

COOPERATION

Memoranda of agreement providing for cooperative research have been entered into or continued during the year with the following bureaus of the United States Department of Agriculture:

Bureau of Agricultural Economics:

1. A study of agricultural adjustment in Texas;
2. Cotton fiber and spinning research (also with the Bureau of Plant Industry and the Texas Engineering Experiment Station);
3. A study to determine the economic and social effects on farms resulting from the operation of a definitely planned program of soil conservation;
4. An estimate of the farm population and farm population movements;
5. The accuracy of small samples for wool shrinkage and grading determinations;
6. A study of Texas farm leasing arrangements in relation to the conservation of agricultural resources.

Bureau of Animal Industry:

1. Investigations of the loco problem in Western Texas;
2. Beef cattle husbandry investigations relating to the fattening of steers at different levels of feeding (also with Bureau of Plant Industry);
3. Beef cattle feeding investigations to determine the quantity of carotene required for growing and fattening steers;
4. Beef cattle feeding investigations relating to mineral-deficiency studies in range beef-cattle production;
5. A study of the inheritance of skin folds in Rambouillet sheep;
6. Improvement of sheep for western ranges through the application of breeding methods;
7. The mechanism of infection, resistance, and immunity in the contagious, infectious, and parasitic diseases of domestic animals and poultry.

Bureau of Chemistry and Soils:

1. Soil surveys in the State of Texas;
2. Research on citrus products and on methods of preservation of fruits and vegetables.

Bureau of Biological Survey:

1. Regional and state wildlife research (also with the Texas Extension Service and the State Game, Fish, and Oyster Commission).

Bureau of Plant Industry:

1. The production, improvement, and diseases of cereal crops, particularly corn, wheat, oats, sorghum, and rice;
2. The production, improvement, and diseases of cotton;
3. Field testing of Satsuma orange varieties and hybrids and stock plants for them;
4. Study and description of American varieties of vegetable crop plants for the purpose of establishing variety type standards;
5. Investigations in the development of forage and soil improving crops

adapted to Northern Texas and contiguous areas (at Substation No. 12, Chillicothe);

6. Experiments in the testing of dates at Substation 15, Weslaco, and in Southwest Texas;
7. Investigations on insecticide and tannin plants and their possibilities as crops in the United States;
8. Vegetable breeding investigations in the Southeastern States and at the U. S. Regional Vegetable Breeding Laboratory;
9. Investigations on introduction, breeding, and testing varieties and seedlings of sweet potatoes;
10. Investigations on the occurrence of boron injury to citrus and other crop plants in the Lower Rio Grande Valley;
11. Studies on establishment of the Perigord truffle *(Tuber melanosporum)* in America.

Bureau of Entomology and Plant Quarantine:

1. Investigations of insects and parasites affecting livestock;
2. Cotton insect investigations, including biology and control of pink bollworm and cotton bollworm;
3. Investigation on the resistance of honey bees to American foulbrood.

Soil Conservation Service:

1. Soil and water conservation research in the State of Texas, at Temple, Tyler, Spur, Amarilla, and Brushy Creek Watershed;
2. Cooperative Western Range Survey in North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (also with Forest Service and Resettlement Administration).

Bureau of Home Economics:

1. Study of body measurements for sizing children's garments and patterns.

FINANCIAL STATEMENT

September 15, 1937

Director A. B. Conner,
Texas Agricultural Experiment Station.

Dear Director Conner:

There is submitted herewith the annual financial report of the Texas Agricultural Experiment Station for the fiscal year ended August 31, 1937.

In accordance with Section 2, Chapter 360, General Laws Forty-fourth Legislature—Regular Session, all exhibits and schedules contained in this report have been prepared as nearly as practicable in conformity with the suggestions made by the National Committee on Standard Reports for Institutions of Higher Education.

Respectfully submitted,

M. P. HOLLEMAN, Chief Clerk.

Approved:
W. H. HOLZMANN,
Comptroller of Accounts.

EXHIBIT A

Texas Agricultural Experiment Station Balance Sheet
As at August 31, 1937

ASSETS

I. CURRENT FUNDS			
A. RESEARCH AND GENERAL			
Cash		$ 105,763.63	
Balance in State Appropriations (Schedule B-1a)		2,547.74	
Feed Control Tags			
Inventory	$ 1,926.61		
C. O. D. Shipments	450.13	2,376.74	
Supplies and Crops Inventories			
Supplies	$ 119,852.95		
Crops	5,593.25	125,446.20	
Total Research and General			$ 236,134.31
B. AUXILIARY ENTERPRISES AND ACTIVITIES			None
C. CURRENT RESTRICTED FUNDS			
Cash		$ 2,391.40	
Total Current Restricted Funds			2,391.40
TOTAL CURRENT FUNDS ASSETS			$ 238,525.71
II. LOAN FUNDS			None
III. ENDOWMENT FUNDS			None
IV. PLANT FUNDS			
A. UNEXPENDED		None	
B. INVESTED IN PLANT			
Physical Plant (Exhibit E)	$1,092,327.88		
Total Invested in Plant		$1,092,327.88	
TOTAL PLANT FUNDS ASSETS			$1,092,327.88
V AGENCY FUNDS			None
GRAND TOTAL ASSETS			$1,330,853 59

EXHIBIT A

Texas Agricultural Experiment Station Balance Sheet
As at August 31, 1937

LIABILITIES

I. CURRENT FUNDS			
A. RESEARCH AND GENERAL			
Accounts Payable			
Main College—Working Fund.....	$ 10,000.00		
Main College—Feed Control Tag Inventory and C. O. D's........	2,376.74	$ 12,376.74	
Reserve for Supplies and Crop Inventories..........................		125,446.20	
Revolving Fund Balances (Schedule B-4)....................		13,075.11	
Current Balances (Exhibit B)			
Appropriated for Special Purposes			
Federal Hatch Fund Balance....	$ 1,403.59		
Federal Adams Fund Balance....	1,250.03		
Federal Purnell Fund Balance....	5,034.45		
Federal Bankhead-Jones Fund Balance....................	16,397.89		
State Apprns. Bals.—Main Sta ..	648.61		
State Apprns. Bals.—Substations.	99.58		
Sales Fund Bals.—Main Station..	26,079.81		
Sales Fund Bals.—Substations...	32,522.75		
Total Appro. for Special Purposes....		83,436.71	
Reserve for Contracts and Orders....		1,799.55	
Total Research and General.........			$ 236,134.31
B. AUXILIARY ENTERPRISES AND ACTIVITIES....................			None
C. CURRENT RESTRICTED FUNDS			
Fund Balances (Per Exhibit B and Schedule B-3)...		$ 2,391.40	
Total Current Restricted Funds......			2,391.40
TOTAL CURRENT FUNDS LIABILITIES..........................			$ 238,525.71
II. LOAN FUNDS......................			None
III. ENDOWMENT FUNDS.............			None
IV. PLANT FUNDS			
A. UNEXPENDED..................		None	
B. INVESTED IN PLANT (Exhibit E)			
Net Investment in Plant...........	$ 1,092,327.88		
Total Invested in Plant.............		$1,092,327.88	
TOTAL PLANT FUNDS LIABILITIES			$1,092,327.88
V. AGENCY FUNDS...................			None
GRAND TOTAL LIABILITIES.......			$1,330,85 .59

EXHIBIT B

Summary Statement of Current Funds

For the Year Ended August 31, 1937

BALANCES, September 1, 1936			
Current Funds—Research and General			
Reserve for Outstanding Orders		$ 2,173.72	
Appropriated for Special Purposes:			
Federal—Hatch Fund	$ 1,227.21		
Federal—Adams Fund	1,250.04		
Federal—Purnell Fund	5,046.47		
Federal—Bankhead-Jones Fund	12,327.03		
State Apprns.—Main Station	1,500.00		
State Apprns.—Substations	85.00		
Sales Funds—Main Station	24,804.23		
Sales Funds—Substations	37,573.00	83,812.98	$ 85,986.70
Current Restricted Funds			
Cuprocide Fund		$ 290.45	
Texas Gulf Sulphur Fund		869.22	
Freeport Sulphur Fund		482.72	
Special Fertilizer Fund		200.00	1,842.39
TOTAL BALANCES, September 1, 1936			$ 87,829.09
ADD:			
Current Research and General Income (Schedule B-1)		$569,637.67	
DEDUCT:			
Current Research and General Expenditures (Schedule B-2)	$569,754.10		
Unused 1935-36 Leg. Appro. reverted (Schedule B-1a)	85.00	569,839.10	
Net Deductions			201.43
BALANCES, August 31, 1937			$ 87,627.66
Consisting of:			
Current Funds—Research and General (To Exhibit A, Section I-A)			
Reserve for Outstanding Orders		$ 1,799.55	
Appropriated for Special Purposes:			
Federal—Hatch Fund	$ 1,403.59		
Federal—Adams Fund	1,250.03		
Federal—Purnell Fund	5,034.45		
Federal—Bankhead-Jones Fund	16,397.89		
State Apprns.—Main Station	648.61		
State Apprns.—Substations	99.58		
Sales Funds—Main Station	26,079.81		
Sales Funds—Substations	32,522.75	83,436.71	85,236.26
Current Restricted Funds			
Cuprocide Fund		$ 583.70	
Texas Gulf Sulphur Fund		1,233.78	
Freeport Sulphur Fund		524.71	
Special Fertilizer Fund		49.21	2,391.40
Total, as shown above			$ 87,627.66

SCHEDULE B-1

Statement of Current Income

For the Year Ended August 31, 1937

	Total	Current General Funds	Current Restricted Funds
I. RESEARCH AND GENERAL			
1. Student Fees (None)			
2. Public Appropriations			
a. Federal			
Hatch Act (1881)	$ 15,000.00	$ 15,000.00	
Adams Act (1906)	15,000.00	15,000.00	
Purnell Act (1925)	60,000.00	60,000.00	
Bankhead-Jones Act (1935)	84,017.68	84,017.68	
Total Federal	$174,017.68	$174,017.68	
b. State Legislative Appropriations (Schedule B-1a and B-1b)	279,605.00	279,605.00	
Total Public Appropriations	$453,622.68	$453,622.68	
3. Endowment Income (None)			
4. Gifts and Grants (Schedule B-3)	$ 5,730.56		$ 5,730.56
. Sales and Services (Schedule B-1c)	109,543.43	109,543.43	
6. Other Sources Interest on Bank Balances	741.00	741.00	
Total Research and General (to Exhibit B)	$569,637.67	$563,907.11	$ 5,730.56

SCHEDULE B-1a

Summary of State Legislative Appropriations

For Fiscal Year Ended August 31, 1937

	Total	Main Station	Substations
Balances, September 1, 1936, from Appropriations for Previous Year	$ 3,758.72	$ 2,552.87	$ 1,205.85
Add Appropriations for Current Year (Schedule B-1b)	279,605.00	140,378.00	139,227.00
Total Balances from Previous Year, plus Appropriations for Current Year	$283,363.72	$142,930.87	$140,432.85
Less Expenditures (Schedule B-2)	280,730.98	141,457.84	139,273.14
Unexpended Balances	$ 2,632.74	$ 1,473.03	$ 1,159.71
Less Reversions to State Treasury from Previous Year Balances (to Exhibit B)	85.00	....	85.00
Balance, August 31, 1937 (to Exhibit A)	$ 2,547.74	$ 1,473.03	$ 1,074.71

SCHEDULE B-1b

Statement of Current Income from State Legislative Appropriations (General Revenue)

For the Year Ended August 31, 1937

(Pages 940 to 948, Gen. Laws, 44th Leg.; Regular Session)

MAIN STATION:		
State Appro.		
Number		
W-1088—Salaries	$ 47,244.00	
Less amount accounted for under Substations	6,138.00	$ 41,106.00
W-1089—Administrative	$ 3,000.00	
Less amount transferred to State Auditor's Dept	225.00	2,775.00
W-1090—Veterinary Science		2,370.00
W-1091—Horticulture		3,350.00
W-1092—Range Animal Husbandry		5,690.00
W-109 —Entomology (Including Foul Brood)		9,604.00
W-1094—Apiculture		5,938.00
W-1095—Agronomy		3,180.00
W-1096—Main Station Farm		4,340.00
W-1097—Plant Pathology		1,830 00
W-1098—Soil Survey		7,847 00
W-1099—Farm and Ranch Economics		4,940.00
W-1100—Publications		3,000.00
W-1101—Botany		200.00
W-1102—Cotton Root Rot Investigations		26,128.00
W-1103—Cotton Insect Investigations		12,380.00
W-1104—Loco Weed Research		5,700 00
Total Main Station		$140,378.00
SUBSTATIONS:		
W-1088—Salaries (See Main Station)		$ 6,138.00
W-1110—No. 1—Beeville		4,088.00
W-1111—No. 2—Tyler		11,082.00
W-1112—No. 3—Angleton and Plant Lice Laboratory		11,188.00
W-1113—No. 4—Beaumont		5,788 00
W-1114—No. 5—Temple		3,750.00
W-1115—No 6—Denton		4,940.00
W-1116—No. 7—Spur		4,695.00
W-1117—No. 8—Lubbock		6,445.00
W-1118—No. 9—Balmorhea		4,088.00
W-1119—No. 10—College Station (Feeding and Breeding)		5,475.00
W-1120—Division of Dairy Husbandry		2.255.00
W-1121—Division of Swine Husbandry		3,855.00
W-1122—Division of Poultry Husbandry		3,440.00
W-1123—No. 11—Nacogdoches		21,288 00
W-1124—No. 12—Chillicothe		4,010.00
W-1125—No. 14—Sonora		11,538.00
W-1126—No. 15—Weslaco (Lower Rio Grande)		9,149.00
W-1127—No. 16—Iowa Park (Wichita Valley)		7,990 00
W-1128—No. 19—Winter Haven		7.995 00
Total Substations		$139,227.00
Total State Legislative Appropriations		$279,605.00

SCHEDULE B-1c

Statement of Current Income from Sales and Services

For the Year Ended August 31, 1937

MAIN STATION:	
Administrative	$ 157.65
Veterinary Science	1,715.43
Horticulture	5.80
Entomology	338.86
Apiculture	81.75
Agronomy	915.56
Main Station Farm	1,977.00
Plant Pathology	95.80
Farm and Ranch Economics	58.95
Loco Weed Research	327.39
Chemical Analysis	18,016.00
Photographic Laboratory	1,990.30
Big Spring Cattle Feeding	2,067.32
Rural Home Research	218.05
Total Main Station	$ 27,965.86
SUBSTATIONS:	
No. 1—Beeville	$ 702.14
No. 2—Tyler	594.13
East Texas Soil Erosion	830.17
No. 3—Angleton	999.45
Plant Lice Laboratory	127.28
No. 4—Beaumont	611.77
No. 5—Temple	367.73
Temple Soil Erosion	2,815.43
No. 6—Denton	4,125.67
No. 7—Spur	4,819.40
No. 8—Lubbock	3,447.33
No. 9—Balmorhea	5,043.08
No. 10—College Station (Feeding and Breeding)	1,173.83
Division of Dairy Husbandry	14,156.20
Division of Swine Husbandry	7,617.07
Division of Poultry Husbandry	3,653.32
No. 11—Nacogdoches	950.64
No. 12—Chillicothe	1,023.01
No. 14—Sonora	13,948.67
No. 15—Weslaco (Lower Rio Grande)	6,559.85
No. 16—Iowa Park (Wichita Valley)	1,648.63
No. 19—Winter Haven	5,394.71
Lubbock Forest Sales	968.06
Total Substations	$ 81,577.57
Total Sales and Services	$109,543.43

SCHEDULE B-2

Statement of Current Expenditures

For the Year Ended August 31, 1937

	FUND DISTRIBUTION						OBJECT CLASSIFICATION			
	CURRENT GENERAL FUNDS									
	Federal Funds	State Apprns.	Sales Funds	Total General	Current Restricted Funds	Grand Total	Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements
RESEARCH AND GENERAL										
Main Station										
Administrative	$ 14,725.31	$ 17,800.55	$ 890.03	$ 33,415.89		$ 33,415.89	$ 29,485.50	$ 3,484.34	$ 446.05	
Veterinary Science	11,712.14	5,520.00	3,006.18	20,238.32		20,238.32	13,668.20	4,676.48	1,831.16	$ 62.48
Horticulture	5,157.62	6,403.71	31.08	11,592.41	$ 155.86	11,748.27	9,982.67	1,546.94	132.81	85.85
Range Animal Husbandry	16,409.49	10,346.71	605.69	27,361.89		27,361.89	22,527.14	3,763.13	1,071.62	
Entomology	6,195.00	24,627.42	678.78	31,501.20	1,711.50	33,212.70	27,589.01	4,636.47	987.22	
Apiculture		5,912.54	46.72	5,959.26		5,959.26	5,522.00	437.26		
Agronomy	17,883.54	7,515.00	887.24	26,285.78		26,285.78	21,640.79	2,851.63	1,073.29	720.07
Main Station Farm		4,340.00	2,898.56	7,238.56		7,238.56	6,068.43	1,148.70	21.43	
Plant Pathology	3,390.00	4,889.35	94.15	8,373.50	3,163.40	11,536.90	9,011.69	1,911.78	613.43	
Soil Survey	238.31	8,329.61	257.31	8,825.23		8,825.23	6,985.31	623.29	1,216.63	
Farm and Ranch Economics	29,453.53	6,894.23	58.95	36,406.71		36,406.71	32,158.50	4,166.13	82.08	
Publications	200.00	4,987.00		5,187.00		5,187.00	2,187.00	2,852.78	147.22	
Botany	1,329.00	1,256.18		2,585.18		2,585.18	2,400.00	158.48	26.70	
Cotton Root Rot Research	540.00	24,350.81		24,890.81		24,890.81	22,117.53	2,616.98	156.30	
Loco Weed Research		5,594.47	182.19	5,776.66		5,776.66	5,180.41	91.50	504.75	
Chemistry	20,942.91		15,670.40	30,613.31		36,613.31	31,686.05	4,066.54	860.72	
Photographic Laboratory		1,350.00	2,033.70	3,383.70		3,383.70	2,220.00	852.03	311.67	
Rural Home Research	17,263.14	192.76	290.30	17,746.20		17,746.20	12,398.90	2,238.51	3,108.79	
Agricultural Engineering	5,680.77	1,147.50		6,828.27		6,828.27	6,316.41	407.54	104.32	
Total Main Station	$151,120.76	$141,457.84	$ 27,631.28	$320,209.88	$ 5,030.76	$325,240.64	$269,145.54	$ 42,530.51	$ 12,696.19	$ 868.40
Substations										
No. 1—Beeville		$ 4,088.00	$ 914.14	$ 5,002.14		$ 5,002.14	$ 4,090.02	$ 891.36	$ 20.76	
No. 2—Tyler	$ 400.00	11,082.00	3,057.41	14,539.41		14,539.41	9,756.20	2,593.20	690.01	$ 1,500.00
No. 3—Angleton		7,088.00	766.30	7,854.30		7,854.30	6,731.60	1,091.24	31.46	
Plant Lice Laboratory		4,130.59	186.47	4,317.06		4,317.06	3,403.00	612.31	301.75	
No. 4—Beaumont		5,772.03	947.98	6,720.01		6,720.01	4,863.02	1,461.31	348.28	47.40
No. 5—Temple		3,750.00	3,590.04	7,340.04		7,340.04	3,306.80	3,955.68	77.56	
No. 6—Denton		4,940.00	2,572.32	7,512.32		7,512.32	5,774.70	1,684.34	53.28	
No. 7—Spur		4,695.00	8,757.67	13,452.67		13,452.67	5,948.31	6,460.55	653.35	390.46
No. 8—Lubbock		6,445.00	3,018.99	9,463.99		9,463.99	7,673.55	1,465.80	324.64	
No. 9—Balmorhea		4,088.00	4,705.36	8,793.36		8,793.36	5,081.87	2,423.91	1,287.58	
No. 10—College Station (Feeding and Breeding)		5,475.00	1,196.84	6,671.84		6,671.84	4,809.00	1,852.09	10.75	
Division of Dairy Husbandry	6,994.71	3,038.00	14,490.69	24,523.40		24,523.40	9,672.05	13,625.26	1,225.19	

Division of Swine Husbandry	4,027.00	6,405.00	9,578.76	20,010.76	....	20,010.76	7,853.75	10,760.44	311.39	1,085.18
Division of Poultry Husbandry	6,340.00	6,245.00	4,108.30	16,693.30	....	16,693.30	10,036.55	6,341.55	195.25	119.95
No. 11—Nacogdoches	....	21,379.71	531.00	21,910.71	....	21,910.71	13,643.65	4,469.65	1,529.88	*2,267.53
No. 12—Chillicothe	600.00	4,040.00	1,041.60	5,681.60	....	5,681.60	4,432.01	1,021.51	228.08	....
No. 14—Sonora	....	11,538.00	15,733.53	27,271.53	....	27,271.53	16,656.69	9,336.81	1,222.03	56.00
No. 15—Weslaco (Lower Rio Grande)	....	9,188.39	5,071.53	14,259.92	....	14,259.92	10,322.21	2,705.88	1,231.83	....
No. 16—Iowa Park (Wichita Valley)	....	7,890.42	2,336.10	10,226.52	....	10,226.52	8,208.14	1,071.56	363.67	583.15
No. 19—Winter Haven	300.00	7,995.00	3,822.79	12,117.79	$ 150 79	12,268.58	9,080.41	2,834.44	270.03	83.70
Total Substations	$ 18,661.71	$139,273.14	$ 86,427.82	$244,362.67	$ 150.79	$244,513.46	$151,344.43	$ 76,658.89	$ 10,376.77	$ 6,133.37
Total Research and General (Exhibit B)	$169,782.47	$280,730.98	$114,059.10	$564,572.55	$ 5,181.55	$569,754.10	$420,489.97	$119,189.40	$ 23,072.96	$ 7,001.77

Consisting of:	
Buildings and Other Improvements	$ 4,734.24
Land	2,267.53
Total	$ 7,001.77
Add Equipment	23,072.96
Total Investment in Plant (Exhibit E)	$ 30,074.73

Analysis by Sources of Funds and Expense Classes

	DISTRIBUTION BY DIVISIONS		Total	DISTRIBUTION BY EXPENSE CLASSES			
	Main Station	Substations		Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements
Research and General Expenditures							
Current General Funds							
Federal Funds							
Hatch Fund	$ 14,123.62	$ 700 00	$ 14,823.62	$ 13,509.56	$ 831.85	$ 482.21	....
Adams Fund	14,400.01	600.00	15,000.01	15,000.01	....	....	....
Purnell Fund	60,012.02	....	60,012.02	54,040.76	4,660.45	1,243.41	$ 67.40
Bankhead-Jones Fund	62,585.11	17,361.71	79,946 82	57,517.04	15,821.35	5,921.31	687.12
Total Federal Funds	$ 151,120.76	$ 18,661.71	$ 169,782.47	$ 140,067.37	$ 21,313.65	$ 7,646.93	$ 754.52
State Appropriations	$ 147,595.84	$ 133,135.14	$ 280,730.98	$ 229,021.86	$ 41,393.12	$ 7,760.22	$ *2,555.78
Sales Funds	27,631.28	86,427.82	114,059.10	48,157.69	54,836.51	7,373.13	3,691.47
Total Current General Funds	$ 326,347.88	$ 238,224.67	$ 564,572.55	$ 417,246.92	$ 117,543.58	$ 22,780 28	$ 7,001.77
Current Restricted Funds (Schedule B-3)	5,030.76	150.79	5,181.55	3,243.05	1,645.82	292.68	....
Total Research and General Expenditures	$ 331,378.64	$ 238,375.46	$ 569,754.10	$ 420,489.97	$ 119,189.40	$ 23,072.96	$ 7,001.77

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*Includes $2,267.53 for purchase of land.

SCHEDULE B-2a

Statement of Federal Hatch Fund

For the State Fiscal Year Ended August 31, 1937

Balance, September 1, 1936	$ 1,227.21	
Received from United States Treasurer	15,000.00	
Balance, September 1, 1936, plus additions		$ 16,227.21
Less Expenditures:		
Personal Services	$ 13,509.56	
Supplies and Materials	209.79	
Communication Service	1.92	
Travel Expenses	504.65	
Contingent Expenses	9.36	
Equipment	551.00	
Buildings and Land	37.34	
Total Expenditures		$ 14,823.62
Balance, August 31, 1937		$ 1,403.59

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-2b

Statement of Federal Adams Fund

For the State Fiscal Year Ended August 31, 1937

Balance, September 1, 1936	$ 1,250.04	
Received from United States Treasurer	15,000.00	
Balance, September 1, 1936, plus additions		$ 16,250.04
Less Expenditures:		
Personal Services	$ 15,000.01	
Total Expenditures		15,000.01
Balance, August 31, 1937		$ 1,250.03

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-2c

Statement of Federal Purnell Fund

For the State Fiscal Year Ended August 31, 1937

Balance, September 1, 1936	$ 5,046.47	
Received from United States Treasurer	60,000.00	
Balance, September 1, 1936, plus additions		$ 65,046.47
Less Expenditures:		
Personal Services	$ 54,040.76	
Supplies and Materials	2,490.68	
Communication Service	271.34	
Travel Expenses	903.29	
Transportation of Things	46.06	
Heat, Light, Water and Power	53.31	
Contingent Expenses	14.25	
Equipment	1,774.75	
Buildings and Land	417.58	
Total Expenditures		60,012.02
Balance, August 31, 1937		$ 5,034.45

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-2d

Statement of Federal Bankhead-Jones Fund

For the State Fiscal Year Ended August 31, 1937

Balance, September 1, 1936	$ 12,327.03	
Received from United States Treasurer	84,017.68	
Balance, September 1, 1936, plus additions		$ 96,344.71
Less Expenditures:		
Personal Services	$ 57,517.04	
Supplies and Materials	9,562.99	
Communication Service	73.96	
Travel Expenses	4,274.54	
Transportation of Things	182.06	
Heat, Light, Water and Power	48.13	
Contingent Expenses	8.00	
Equipment	6,200.80	
Buildings and Land	2,079.30	
Total Expenditures		79,946.82
Balance, August 31, 1937		$ 16,397.89

Note: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-3

Statement of Current Restricted Funds

For the Year Ended August 31, 1937

	INCOME		Total Balance and Additions	EXPENDITURES				Balance Aug. 31, 1937 (Exh. A; B)
	Balance Sept. 1, 1936	Gifts (Sch. B-1)		Salaries and Wages	Other Operating Expense	Equipment	Total	
FOR RESEARCH AND GENERAL PURPOSES								
Texas Gulf Sulphur Fund......	$ 869.22	$ 2,541.67	$ 3,410.89	$ 1,378.35	$ 1,650.16	$ 148.60	$ 2,177.11	$ 1,233.78
Cuprocide Fund..............	290.45	1,000.00	1,290.45	464.53	232.27	9.95	706.75	583.70
Freeport Sulphur Fund.......	482.72	2,188.89	2,671.61	1,357.01	655.76	134.13	2,146.90	524.71
Special Fertilizer Fund.......	200.00	....	200.00	43.16	107.63	....	150.79	49.21
Total Research and General...	$ 1,842.39	$ 5,730.56	$ 7,572.95	$ 3,243.05	$ 1,645.82	$ 292.68	$ 5,181.55	$ 2,391.40

SCHEDULE B-4

Transactions of Revolving Funds

For the Year Ended August 31, 1937

	CREDITS		Total Balance and Additions	EXPENDITURES				Credit Balance Aug. 31, 1937 (Exh. A)
	Credit Balance Sept. 1, 1936	Sales		Salaries and Wages	Other Operating Expense	Equipment	Total	
FOR ORGANIZED RESEARCH								
Wool Scouring Plant..........	$ 511.71	$ 2,989.79	$ 3,501.50	....	$ 3,229.43	$ 20.30	$ 3,249.73	$ 251.77
Cattle Feeding Revolving Fund	8,905.85	9,495.01	18,400.86	....	....	5,577.52	5,577.52	12,823.34
Total Organized Research..	$ 9,417.56	$ 12,484.80	$ 21,902.36	....	$ 3,229.43	$ 5,597.82	$ 8,827.25	$ 13,075.11

EXHIBIT E

Summary Statement of Investment in Plant

At August 31, 1937

CARRYING VALUE OF PLANT, SEPTEMBER 1, 1936...		$1,063,702.28
ADDITIONS DURING 1936-37:		
1. Expended from Plant Funds (None)................	....	
2. Expended from Current General Funds.............	$ 29,782.05	
3. Expended from Current Restricted Funds (Sch. B-3).	292.68	
Total Current General and Current Restricted Funds (Schedule B-2)....................	$ 30,074.73	
4. Expended from Revolving Funds (Schedule B-4).....	5,597.82	
5. Expended from Feed Control Service Funds (Exh. G)..	1,022.92	
6. Adjustments to previously reported values (Schedule E-2 and 3).................................	10,249.18	
Total Additions..		46,944.95
Carrying Value of Plant, September 1, 1936, plus additions....		$1,110,647.23
DEDUCT:		
1. Sale of Equipment (Schedule E-3)..................	$ 9,495.01	
2. Plant Assets worn out, discarded, etc. (Schedule E-2 and 3).................................	8,824.34	
Total Deductions..		18,319.35
VALUE OF PLANT, August 31, 1937 (to Exhibit A)........		$1,092,327.88
Value of Plant at August 31, 1937 Made up as follows:		
Land..		$ 271,488.63
Buildings....................................	$ 389,035.86	
Improvements Other Than Buildings..............	35,190.78	
Total Buildings and Other Improvements.......		424,226.64
Equipment....................................		396,612.61
Total (to Exhibit A)..................................		$1,092,327.88

SCHEDULE E-1

Summary Statement of Inventory Valuation

At August 31, 1937

MAIN STATION		
Administrative		$ 40,682.61
Veterinary Science		33,057.19
Horticulture		18,135.91
Range Animal Husbandry		26,849.31
Entomology		17,345.15
Apiculture		17,099.28
Agronomy		19,617.09
Main Station Farm		44,195.44
Plant Pathology and Physiology		8,348.79
Soil Survey		2,495.06
Farm and Ranch Economics		6,078.10
Publications		46,852.30
Botany		2,926.97
Loco Weed Research Laboratory		3,409.21
Chemistry		36,243.47
Photographic Laboratory		4,942.32
Rural Home Research		19,346.40
Agricultural Engineering		6,819.43
Feed Control Service		5,493.81
Total Main Station		$ 359,937.84
SUBSTATIONS		
No. 1 Beeville		$ 20,892.00
No. 2 Tyler		37,160.95
No. 3 Angleton		25,554.27
Plant Lice Laboratory		4,584.35
No. 4 Beaumont		36,968.67
No. 5 Temple		55,710.03
No. 6 Denton		31,616.75
No. 7 Spur		60,131.59
No. 8 Lubbock		35,976.78
No. 9 Balmorhea		31,850.54
No. 10 College Station (Feeding and Breeding Station)		44,543.66
Division of Dairy Husbandry		24,314.84
Division of Swine Husbandry		18,787.68
Division of Poultry Husbandry		19,064.65
No 11 Nacogdoches		40,384.19
No. 12 Chillicothe		32,519.45
No. 14 Sonora		152,665.29
No. 15 Weslaco (Lower Rio Grande)		115,356.67
No. 16 Iowa Park (Wichita Valley)		33,007.12
No. 19 Winter Haven		36,746.76
Total Substations		$ 857,836.24
Total Inventory Valuation		$1,217,774.08
Consisting of:		
Supplies and Crops Inventories	$ 125,446.20	
Invested in Plant	1,092,327.88	
Total	$1,217,774.08	

EXHIBIT F

Transactions of the Feed Control Service

For the Fiscal Year Ended August 31, 1937

INCOME			
Tag Sales		$ 144,355.19	
Total Income			$ 144,355.19
EXPENDITURES			
Salaries and Wages			
Administrative Salaries		$ 9,225.00	
Instruction and Research Salaries		19,369.96	
Clerical and Stenographic Salaries		9,830.00	
Other Salaries		1,643.04	
Wages		1,012.37	41,110.37
Consumable Supplies			
Postage, Stationery and Office Supplies		$ 1,756.37	
Laboratory Supplies		66.20	
Fuel			
Feeding Supplies		345 87	
Tags (Purchased)		19,530.88	
Other Consumable Supplies		289.82	21,989.14
Expense			
Telegraph and Telephone		$ 284.59	
Travel		10,314.83	
Transportation of Things (Service)		21.96	
Publications		7,216.52	
Heat, Light, Power, Water and Gas		2,460.14	
Other Current Expense (Including Chemical Analysis)		18,208.65	
Refunds		193.70	38,700.39
Repairs and Alterations			
Repairs to Buildings		$ 181.77	
Other Repairs		683.30	865.07
Total Salaries and Wages plus Operating Expenses			$ 102,664.97
Equipment			
Main Office			
Furniture and Office Equipment	$357.34		
Books	32.68		
Machinery and Tools	19.40		
Other Equipment	13.50		
Total Main Office		$ 422.92	
Other Divisions			
Division of Botany			
Herbarium	$600.00		
Total Other Divisions		600.00	
Total Equipment			1,022.92
Total Expenditures			$ 103,687.89
Surplus transferred to A. and M. College			$ 40,667.30
Total Expenditures and Surplus			$ 144,355.19